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De moraalpsychologie van incestaversie



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The moral psychology of sibling incest aversion

Evolutionary origins and legal future

Proefschrift voorgelegd tot het behalen van de graad van
Doctor in de moraalwetenschappen

2014

Acknowledgements

The people who deserve my greatest acknowledgement are my parents, Daisy Vandebuerie and Philippe Bovyn. They had and continue to have a great and uttermost positive influence on who I am and on the things that I value in life. Through all life stages they have provided me with adequate support and guidance, always encouraging me to find my own way in life. I cannot put down in words how much I am thankful to them.

Secondly, I am greatly thankful to my advisor, prof. dr. Jan Verplaetse, first of all for guiding me through the process of writing a master's thesis, and after that, for inviting me to apply for the job of assistant at the former department of Legal Theory and Legal History at the Law Faculty of Ghent University. He gave me the opportunity to start up this research, and has been a terrific guide throughout the whole process.

During the course of my PhD research I was very thankful to be cooperating with, and receive much-welcomed advice and mentorship from prof. dr. Johan Braeckman, dr. Dieter Jehs, prof. dr. Debra Lieberman, dr. Joshua Tybur, dr. Katinka Quintelier, dr. Michiel van Elk, dr. Lien Van Speybroeck and all the members of the Moral Brain Research Group and of the Human Evolution and Behavior Network (HEBeN). I wish to express special thanks to prof. dr. Debra Lieberman for inviting me for a research stay at the University of Miami, which took place from April to July 2013. This research stay however would also not have been possible without the travelling grant that was given to me by the FWO Flanders, for which I am thankful.

I was happy to have colleagues around me to mutually share research related enjoyments, and obviously sometimes also frustrations. I would like to express thanks to all the colleagues of the former department of Legal Theory and Legal History at the Law faculty of Ghent University, and all the members of the Moral Brain Research Group. Over the course of the years some of these colleagues became friends. Special thanks to Stephen Billion, Eveline Seghers and Nancy Van Nuffel for the support and the happy moments we've shared.

During the course of my research I was lucky to enjoy the companionship of office buddies dr. Valérie Smet (2010-2012) and Charles Delmotte (2013-2014). Thanks to them I enjoyed an excellent working atmosphere.

I was lucky to receive the support and friendship of several people outside of academia. For this I wish to express special thanks to Jan Buyse, Mieke Carrein, Sien Gernaert, Rudi Jehs, Regis Lefebvre, Stefanie Van Heule, Martine Verbeke, and Stefanie Vandewalle.

Lastly, I choose to thank three people that mean a great deal to me, each in their own way. I thank Dieter Jehs, for having been a great companion along the way, and for his continued support up until the final stages. I thank Tiago Soares Bortolini, for being a beloved friend and confidant despite all the kilometers between us. And I thank Davy Teirlynck for so much kindness and love.

List of Tables

Table 1	Overview of physiological output prior to data reduction: 6 SCR data (SCR a to f), 12 fEMG data (fEMG a to l) and 12 HR data (HR a to l)	47
Table 2	Paired samples t-tests: 1st vs. 2nd interval variables and mild vs. explicit sex variables	50
Table 3	Repeated measures ANOVAs on fEMG, HR and SCR variables (after first data reduction)	51
Table 4	Number and type of brothers	52
Table 5	Independent samples T-tests for differences in fEMG responses between females without brothers and females with at least one brother	54
Table 6	fEMG responses and coresidence duration, attitudes towards sexuality in the family, and disgust sensitivity	54
Table 7	EMG responses and brother relation characteristics (subjects with 1 brother)	55
Table 8	Paired samples t-tests: 1st vs. 2nd interval variables and mild vs. explicit sex variables (males, N=66)	66
Table 9	Paired samples t-tests: 1st vs. 2nd interval variables and mild vs. explicit sex variables (females, N=104)	67
Table 10	Frequencies of strong (SPI) and weak (WPI) indicators for shared parental investment for oldest opposite-sex sibling.	69
Table 11	Females: Bivariate correlations between fEMG when imagining sex with a brother and (1) coresidence duration with oldest brother, (2) genetic relatedness with oldest brother, (3) cues for shared parental investment with oldest brother and (4) openness towards sexuality in the family	72
Table 12	Males: Bivariate correlations between EMG measurements and openness towards sexuality in the family and disgust sensitivity	76
Table 13	Males: Bivariate correlations of EMG measurements and (1) coresidence duration with oldest sister, and (2) cues for shared parental investment with oldest sister	77
Table 14	Repeated Measures ANOVA for differences in fEMG responses between specific word primes within each priming condition (family/not family)	94
Table 15	Repeated Measures ANOVA for differences in subjective rating responses between specific word primes within each priming condition (kin/not kin)	95
Table 16	Comparative overview of IAT effect sizes in a selection of recent studies that use Greenwald et al.'s (2003) scoring algorithm	145

Table 17	Illustration of correlations between IAT and explicit counterparts in a selection of recent research involving sexuality measures	148
Table 18	Pearson's Correlation Coefficients of Moral Attitudes regarding Consensual Sibling Incest and Self-Reported Emotional Intensity	158
Table 19	Is a cognitive reappraisal of harm-related arguments mainly responsible for changes in moral attitudes?	161
Table 20	Summary of research questions, methods and results of the studies described in chapters 7 and 8	166

List of Figures

Figure 1	Lieberman et al.'s (2007) model of the computational architecture of human sibling detection	14
Figure 2	Tooby et al.'s (2008) model of the computational architecture of the sexual and altruistic motivational systems	15
Figure 3	Figure displaying electrode placement for facial electromyography (figure derived from Fridlund & Cacioppo, 1986)	32
Figure 4	Image showing electrode placement for measurement of facial electromyography in the <i>levator labii</i> region	32
Figure 5	Image showing showing electrode placement for measurement of skin conductance responses	35
Figure 6	Procedural sequence of one trial. Instructions displayed were either 'Imagine that you perform the following act with your partner' or 'Imagine that you perform the following act with your brother'	45
Figure 7	error bars (mean + 95% C.I.) of EMG, SCR and HR variables.	49
Figure 8	Error bars (mean and 95% mean C.I.) of EMG responses in females (N=104)	67
Figure 9	Error bars (mean and 95% mean C.I.) of EMG responses in males (N=66)	68
Figure 10	Error bars (mean and 95% mean C.I.) of HR responses in males (N=66)	68
Figure 11	Error bars (mean and 95% mean C.I.) of SCR responses in males (N=66)	69
Figure 12	Scatterplot of fEMG 1 responses set out against coresidence duration with oldest brother from subject's birth until the age of 18 (female subjects)	73
Figure 13	Scatterplot of fEMG 1 responses set out against strong predictors for shared parental investment with oldest brother from subject's birth until the age of 6 (female subjects)	73
Figure 14	Scatterplot of fEMG 2 responses set out against strong predictors for shared parental investment with oldest brother between subject's ages of 7 and 12 (female subjects)	74
Figure 15	Overview of experimental designs of fEMG studies: implicit and explicit priming of 'incest' and experienced aversion. For each experimental design, the time lapse, procedures and stimuli are given for one trial.	88
Figure 16	Immediately after display, each image was rated on this visual analogue scale.	91
Figure 17	Mean fEMG responses towards neutral, pathogen, heterosexual sex and homosexual sex images in each experimental task. 'K' refers to images	

	preceded by a word referring to kinship, 'NK' refers to images preceded by a word not referring to kinship.	95
Figure 18	Mean self-report measures towards neutral, pathogen, heterosexual sex and homosexual sex images in each experimental task. 'K' refers to images preceded by a word referring to kinship, 'NK' refers to images preceded by a word not referring to kinship.	96
Figure 19	Mean fEMG responses towards neutral, pathogen, heterosexual sex and homosexual sex images, displayed separately for each priming condition (i.e., kinship/not kinship)	97
Figure 20	Mean self-report measures towards neutral, pathogen, heterosexual sex and homosexual sex images, displayed separately for each priming condition (i.e., kinship/not kinship)	98
Figure 21	Changes to the Law of Incest in Scotland, 1567–1986 (Leeming, 1996, p. 321).	111
Figure 22	Schematic overview of empirical findings on moral decision making about consensual sex between adult siblings, and predictors of inter-individual variability	130
Figure 23	Comparison of the procedural structure of a classic Implicit Association Test (IAT) and a Single-Category Implicit Association test (SC-IAT)	138
Figure 24	Mean values and standard deviations of moral attitudes towards consensual sex between adult siblings, displayed for each experimental phase.	156
Figure 25	Mean values and standard deviations of moral attitudes towards marriage between adult siblings, displayed for each experimental phase.	156
Figure 26	Mean values and standard errors of moral attitudes towards consensual sex between adult siblings: comparison of attitudes depending on legal views.	157
Figure 27	Mean values and standard errors around the mean of moral attitudes towards marriage between adult siblings: comparison of attitudes depending on legal views.	157

Table of Contents

Introduction	1
<i>Part I. The evolutionary origins of sibling incest aversion</i>	<i>3</i>
Introduction and Overview	5
Chapter 1 Uncovering the origins of the human aversion for incest: an ongoing interdisciplinary research project.....	7
1.1 Early theories on the origins of the incest taboo.....	7
1.2 The evolved psychology of sexual aversion for sex with siblings.....	11
1.2.1 Theoretical background	11
1.2.2 Empirical research	16
1.2.3 The relation between sexual aversions, moral attitudes and the origins of incest taboo	21
1.3 Disgust as an embodied experience	26
1.3.1 The facial disgust expression.....	27
1.3.2 Other physiological responses to disgusting stimuli	33
1.3.3 The relation between affective and physiological components of disgust	35
1.4 An additional methodological avenue for the study of incest aversion	36
Chapter 2 In young adult females, childhood coresidence duration with a brother predicts fEMG measured facial disgust to imagined sex with that brother	39
2.1 Introduction	39
2.2 Methods.....	41
2.2.1 Participants	41
2.2.2 Materials	42
2.2.3 Procedure.....	44
2.2.4 Data recording and preparation.....	46
2.2.5 Data reduction	48
2.3 Results	52

2.3.1	Descriptive statistics: sexual orientation and type of brother(s)	52
2.3.2	Feasibility of imagining brother versus partner acts	53
2.3.3	Effects of coresidence duration, attitudes towards sexuality in the family, and disgust sensitivity (all subjects)	53
2.3.4	Effects of specific experiences with brothers in childhood (subjects with one brother)	55
2.4	Discussion	55
Chapter 3	fEMG-measured facial disgust when imagining sex with a sibling, part 2: gender differences and cues for shared parental investment.....	59
3.1	Introduction	59
3.2	Methods.....	62
3.2.1	Participants	62
3.2.2	Materials	62
3.2.3	Procedure	63
3.2.4	Data recording and preparation	63
3.2.5	Data reduction	64
3.3	Results	69
3.3.1	Descriptive information on oldest opposite-sex sibling	69
3.3.2	Gender differences in fEMG responses to imagined sex with an opposite-sex sibling	70
3.3.3	Critical tests: females	70
3.3.4	Critical tests: males	74
3.4	Discussion	78
Chapter 4	Can sexual aversion for incest be implicitly primed?	83
4.1	Introduction	83
4.2	Methods.....	89
4.2.1	Participants	89
4.2.2	Materials	89
4.2.3	Procedure	91
4.2.4	fEMG data recording and preparation	92
4.2.5	Data reduction	93
4.3	Results	96
4.3.1	fEMG-measured facial disgust	96
4.3.2	Self-Reports of enjoyableness	97
4.4	Discussion	99
	Summary and conclusion	101
	 <i>Part II. The legal future of consensual sex between adult siblings</i>	 <i>105</i>
	Introduction and overview.....	107

Chapter 5	Justifications of legal restrictions on consensual sex and relationships between adult close family members	109
5.1	Introduction	109
5.2	Harm-related arguments	113
5.2.1	Harm to the family unit	113
5.2.2	Harm to vulnerable family members	113
5.2.3	Genetic harm	114
5.2.4	Harm to the well-being of children	115
5.3	The morality argument	115
5.3.1	The factual component	115
5.3.2	The normative component	116
5.4	The future of laws on consensual adult incest	118
5.5	Concluding remarks	120
Chapter 6	Moral attitudes about consensual sex between adult kin	123
6.1	The structure of moral decision making about incest	123
6.1.1	Intuitive processes	123
6.1.2	Cognitive processes	124
6.2	Explanatory models	126
6.2.1	The cultural psychological hypothesis	127
6.2.2	The empathic disgust response hypothesis	128
6.3	Concluding remarks	131
Chapter 7	How strongly is sibling incest morally opposed at the implicit level? ..	133
7.1	Introduction	133
7.2	The implicit association test	135
7.3	Methods	138
7.3.1	Participants	138
7.3.2	Materials	139
7.3.3	Procedure	140
7.3.4	Data preparation	141
7.3.5	Reliability and validity	142
7.3.6	Exploratory analyses	142
7.3.7	Statistical analyses	143
7.4	Results	143
7.4.1	Do subjects display an implicit bias for incest/morally wrong?	143
7.4.2	Do males and females differ in implicit bias for incest/morally wrong?	144
7.5	Discussion	144
Chapter 8	The malleability of moral attitudes towards consensual sex between adult relatives	149
8.1	Introduction	149
8.2	Methods	151
8.2.1	Participants	151
8.2.2	Materials	151

8.2.3	Procedure	153
8.3	Results	154
8.3.1	(Change in) moral judgments	154
8.3.2	Predictors of (changes in) moral judgments	158
8.4	Discussion	159
Summary and conclusion		163
Conclusion.....		167
Bibliography.....		171
Appendix		183

Introduction

The dissertation at hand is the culmination point of nearly six years of scientific research, while being employed as an academic assistant at the former Department of Legal Theory and Legal History of the Law Faculty of Ghent University. Its central topic is the human aversion for incest, in the sense of both an individually experienced sexual aversion and an outcome of moral decision making.

My interest for human incest aversion however arose prior to those six years. It actually dates back to when I was a bachelor student in Moral Sciences at Ghent University. The teachings by prof. dr. Johan Braeckman during my first bachelor year, introduced me to evolutionary psychology. This body of theory traces the origins of our psychology back to our ancestral environment, and helps us understand components of current human behaviour. I experienced this as an extremely enlightening viewpoint for the study of the human mind, and I starting digging into evolutionary psychological writings during the remainder of my bachelor education.

Somewhere along the way, the evolutionary psychological origins of the universal taboo on incest grabbed my attention in particular. On the one hand, it seemed logical that, given its widespread occurrence, this taboo could be linked to evolved psychological mechanisms that developed during the course of our ancestral history. But on the other hand it was extremely fascinating that such a typically cultural phenomenon may in its essence be nothing more than a side-effect of psychological adaptations that make us behave in ways that make sense from a survival and reproduction point of view.

By 2007, when I had to decide about the subject of my Master's thesis, I was not only convinced about the firm ground of this evolutionary psychological hypothesis for the origins of incest aversion, but also that a lot more work on this topic could still be done. Prof. dr. Johan Braeckman and my later advisor, prof. dr. Jan Verplaetse encouraged me to take up human incest aversion as the central topic of my Master's thesis. I accepted the suggestion made by prof. dr. Jan Verplaetse to scrutinize the alleged incestuous unions in an isolated community in Flanders during the nineteenth century. Doing this

research was a lot of fun, and upon finishing in 2008, my interest in the topic of human incest aversion was instigated completely.

In 2009, I was lucky to be hired as an academic assistant at the Law Faculty of Ghent University under the supervision of prof. dr. Jan Verplaetse. Instead of being surrounded by philosophers and moral scientists, I now became embedded in legal academics. On occasion, the difference in 'thinking mode' (for lack of a better word) among my colleagues was very enriching to me. It certainly contributed to my decision to take a step back from my own evolutionary psychological way of thinking, and spend an equal amount of attention to the contemporary social and legal relevance of the incest taboo.

As the reader will have noticed, this dissertation will consist of two parts, reflecting the development I went through during my research. The focus of the first part lies on the evolved psychological origins of human incest aversion. Chapter 1 zooms in on the development of this field, and aims to provide an up to date overview of its progress in terms of both theoretical and empirical work. By the end of this chapter, an argument is made for an additional methodological approach that seeks to further this field of inquiry. What follows, in chapters 2, 3 and 4, are three empirical studies which put into practice this additional approach. Their purpose is twofold. First, I aim to provide additional empirical evidence for theoretical predictions regarding sibling incest aversion; second, I wished to explore the potential of this method as a generator of new empirical insights.

In contrast to the first part, that focuses on the origins of human incest aversion, the subject of the second part is the incest taboo as it exists in western societies today. I converged on the tension between the reigning principle of mutual consent for the evaluation of sexual behaviour, and the continued existence of legal constraints on consensual sexual relationships between adult close kin. It was this disparity that compelled me to compile and critically examine the arguments set forth to back up and defend these legal constraints. In the chapters that follow, I explore, on empirical grounds, the feasibility in moral psychological terms of increasing the social acceptability of freedom of partner choice when it comes to close kin.

On a more general note, I have aimed to take up an interdisciplinary perspective across my research. This was a deliberate choice, since this is what Moral Sciences stand for. More in particular, it also reflects the interdisciplinarity which the department that I worked for strives to represent.

Part I. The evolutionary origins of sibling incest aversion

Introduction and Overview

In 2000, a conference on the origins of the incest taboo took place at Stanford University, followed by the publication of an edited volume which brought together viewpoints of scholars representing both the biological and the social sciences (Wolf & Durham, 2004). The volume breathes the consensus that any social scientist who wishes to study the cultural incest taboo somehow needs to take into account its biological origins, if only for the genetically deleterious effects of inbreeding. This certainly applies to anyone who wishes to study incest aversion as a moral attitude displayed by the individual, which, as we will discuss in this part, generally manifests itself as a moral rejection of incestuous behaviour in others. This mainstream position has remained unchallenged for over fifteen years, mostly due to the theoretical and empirical progress made on this topic in evolutionary psychology.

Evolutionary psychology links moral judgments about incestuous behaviour to sexual aversion experienced when depicting sex with our own kin. The latter can be identified through so-called kin detection abilities that are part of our evolved mind. It is believed that our moral attitudes are a natural corollary of the lack of sexual attraction to close kin, consciously experienced as a sexual aversion. Chapter 1 provides an overview of the theoretical background and the empirical work in support of this hypothesis. At the closing of this first chapter, we will elaborate on the methodological development of the field. What we propose is that, instead of focusing almost exclusively on self-reports of moral attitudes and sexual aversions, we'd better look at incest aversion as an embodied experience, which includes both a subjective/affective and a physiological component.

As such, chapters 2, 3 and 4 each present an empirical study built on this additional methodological approach. First, we aimed to test whether the method is able to replicate theoretical predictions that have been confirmed in the past by self-reports (chapters 2 and 3). Subsequently, we explored the potential of analysing physiological responses to infuse the field with new empirical insights (chapters 3 and 4). If proving to be useful, this method could greatly add to the further development of the study of human incest aversion at large.

Chapter 1 Uncovering the origins of the human aversion for incest: an ongoing interdisciplinary research project.

1.1 Early theories on the origins of the incest taboo

The modern-day interest into tracing the origins of the incest taboo originates with nineteenth-century anthropologists, who attested the sometimes strongly diverging kinship structures in non-western societies (Turner & Maryanski, 2005). At the time, many theories were developed for explaining the concepts of marriage and family, as well as the presence of the incest taboo. Most of these accounts considered the incest taboo as a phenomenon that had no ties whatsoever with biology. From the second half of the twentieth century onwards, many authors have extensively summarized and commented on these non-biologically inspired hypotheses (see e.g., Aberle, 1963; Leeming, 1996; Turner & Maryanski, 2005; for an analysis on the rejection of biological explanations by traditional anthropological accounts, see Parker, 1976). Therefore, we shall limit ourselves to merely highlighting the more important aspects of some of these traditional anthropological accounts. Important to note however, is that each of them refuted the idea that humans are spontaneously aversive to sex with their closest relatives. In other words, they all asserted that a cultural taboo is required to refrain people from behaving in a sexual way with close kin. A notable explicit opponent of this widespread belief was Edward Westermarck. We will elaborate on his hypothesis on the origins of the incest taboo at the end of this section. As will become clear in section 1.2, it came to be the basis for current theoretical models regarding human sexual aversion for incest.

Early on, Lewis Henri Morgan (1877) argued that the earliest family structures were consanguineous, e.g. consisting of marriages between brothers and sisters. After this stage, the family developed through several intermediate stages into its current form, i.e. the monogamous non-incestuous family. The introduction of a taboo on incest was

linked to a recognition of its bad outcomes (presumably, the deleterious outcomes of inbreeding).

According to sociologist Emile Durkheim (1897), the incest taboo originates in the rule of exogamy. In clan-based society, i.e. characterized by social structures organized around a shared totem¹, members of the same clan were prohibited to have sexual contact, as the totem represented shared blood. The taboo on 'incest' naturally developed later on, in unison with the emergence of social structures that were no longer centered around a totem but around shared genetic descent.

Sigmund Freud (1913) hypothesized that the earliest human institution may have been matriarchy, but developed into the horde, a patriarchally organized social structure lacking a taboo on incest. The patriarch was a dominant father, who kept all the women in the horde to himself, and drove his sons away as they grew up. One day, the sons however decided to bundle their powers, and by doing so they were able to overthrow this dominant father figure. As Freud indicates, the idea of overthrowing the dominant male is indebted to Atkinson (Lang & Atkinson, 1903). After the killing, according to Freud (1913), ambivalent feelings of hatred and admiration towards the deceased father, made the sons feel remorseful. These feelings of regret, and the urge to impede a repetition of this act, motivated the sons to create the incest taboo. Along with the institution of the law against incest, totemism introduced itself as the new societal structure (with the totem animal as a substitute for the deceased father). Despite the incest taboo, human's natural state has not changed, and can for instance still be observed in the incestuous feelings that characterize children's earliest sexual excitations. Since the emergence of the taboo, these feelings however are tried to be repressed.

To explain the existence of incest taboos Bronislaw Malinowski (1927) referred to the devastating consequences that within-family sexual behaviour would bring to the family as an organisational structure. This is often referred to as the functionalist account, as the existence of the incest taboo is explained in terms of delineating the roles of family members, especially those within the nuclear family.

Claude Lévi-Strauss' (1948) explanation for the origin of the incest taboo, on the other hand, revolves around the concept of inter-group integration. For this to happen, mutual exchange systems had to be developed. One particular type referred to the interchange of women as marriage partners. These bridal exchanges allowed the development of alliances along kinship lines, which was hypothesized to be a strategy that promoted solidarity and decreased the chance of inter-group conflicts. However, to

¹ Totemism has long been an important construct in theories on human societal organization. See, e.g., Frazer (1910).

make such a patrilocal residence system possible, a prohibition on marriage between close kin was needed, according to Lévi-Strauss. This account is commonly referred to as ‘alliance theory’.

In hindsight, the most crucial figure among these early theorists was Edward Westermarck (1891, 1908). Westermarck wrote on an extensive array of subjects, including suicide, celibacy, homosexuality, cannibalism, and the origins of marriage. He for instance criticized the at that time widespread notion that the earliest human societies had been characterized by promiscuity (Westermarck, 1891). A substantial discussion of Westermarck’s writings obviously falls outside of the range of this dissertation. However, essential to us is his position regarding the origins of the incest taboo, which he himself summarizes as follows:

“What I maintain is, that there is an innate aversion to sexual intercourse between persons living very closely together from early youth, and that, as such persons are in most cases related, this feeling displays itself chiefly as a horror of intercourse between near kin.” (Westermarck, 1891, p. 320)

Westermarck linked this spontaneous sexual aversion to the detrimental effects of inbreeding:

“Taking all these facts into consideration, I cannot but believe that consanguineous marriages, in some way or other, are detrimental to the species. And here I find a quite sufficient explanation of the horror of incest; not because man at an early stage recognised the injurious influence of close intermarriage, but because the law of natural selection must inevitably have operated. Among the ancestors of man, as among other animals, there was no doubt a time when blood-relationship was no bar to sexual intercourse. But variations, here and elsewhere, would naturally present themselves; and those of our ancestors who avoided in-and-in breeding would survive, while the others would gradually decay and ultimately perish. Thus, an instinct would be developed which would be powerful enough, as a rule, to prevent injurious unions.” (Westermarck, 1891, p. 352)

Westermarck explained that this aversion should be understood as an active experience of disgust, and not the mere experience of sexual indifference due to co-habitation:

“But there are instincts just as complicated as this feeling, which, in fact, only implies that disgust is associated with the idea of sexual intercourse between persons who have lived in a long-continued, intimate relationship from a period of life at which the action of desire is naturally out of the question. This association is not matter of course, and certainly cannot be explained by the mere liking of novelty. It has all the characteristics of a real, powerful instinct, and bears evidently a close resemblance to the aversion to sexual intercourse with individuals belonging to another species.” (Westermarck, 1891, p. 353)

Moreover, according to Westermarck, this natural aversion caused the emergence of the cultural taboo on incest:

“Generally speaking, there is a remarkable absence of erotic feelings between persons living very closely together from childhood. Nay more, in this, as in many other cases, sexual indifference is combined with the positive feeling of aversion when the act is thought of. This I take to be the fundamental cause of the exogamous prohibitions. Persons who have been living closely together from childhood are as a rule near relatives. Hence their aversion to sexual relations with one another displays itself in custom and law as a prohibition of intercourse between near kin.” (Westermarck, 1922, p. 192-193)

As Sesardic (2004) nicely summarized, Westermarck’s theory about the origins of the incest taboo breaks down into three components: (1) a sexual aversion tends to develop between those raised together in childhood, (2) this aversion is an evolutionary adaptation (that serves as a barrier to inbreeding depression) and (3) the aversion causes the incest prohibition. In other words, the cultural incest taboo originates from spontaneous disinclinations, experienced at the individual level, and is characterized by an experience of aversion when the act is thought of.

Early on, Westermarck’s hypothesis was criticized, to which he wrote substantial replies (e.g., Westermarck, 1917, p. 371 and further; Westermarck, 1934). Freud (1913) for instance argued that the hypothesis of, what he called, an instinctive dislike is unlikely, since incest is a common phenomenon in current society, and incestuous marriages have even been socially accepted during occasions in history. In response, Westermarck asserted that the general absence of incest is what needs explanation, not its occasional occurrence:

“Considering the extreme variability to which the sexual impulse is subject, it is not astonishing that cases of what we consider incestuous intercourse sometimes do occur. It seems to me more remarkable that the abhorrence of incest should be so general, and the exceptions to the rule so few.” (Westermarck, 1917, p. 373)

In response to the critique that his hypothesis failed to explain why a taboo on sexual contact often applies to the members of an entire clan (or, more broadly, to individuals with whom one does not experience close association during childhood), Westermarck wrote:

“According to my own theory, again, the prohibition of marriage between near relatives living closely together has been extended to all the members of the clan on account of the notion of intimacy connected with the idea of a common descent and a common name.” (Westermarck, 1917, p. 377).

and, in addition:

“an exogamous clan is very frequently a territorial group as well as a group of kindred. But the members of the same clan are prohibited from intermarrying even though they do not live in the same locality. This is a natural consequence of the fact that the aversion to sexual intercourse between persons living closely together from childhood has been expressed in prohibitions against unions between kindred. The exogamous rules, though in the first place associated with kinship because near relatives normally live together, have come to include relatives who do not live together – a process in which the influence of a common name, signifying kinship, has undoubtedly been of great importance.” (Westermarck, 1934, p. 38)

Most often cited, however, is the claim that the mere existence of the incest taboo alone is sufficient to prove that Westermarck’s hypothesis cannot hold true. This argument originates in Frazer (1910). To him it seemed illogical why a behaviour that is already spontaneously declined would still be widely prohibited in custom and law. Spontaneous disinclinations, including keeping our hands away from fire, do not need additional reinforcement by law, according to Frazer (1910). However, as formulated by Parker (1976, p. 286), while the universality of a need or behavioural manifestation may not constitute proof of its instinctive quality, the existence of a cultural taboo is by itself indeed no indication of its absence.

Leaving the debate aside, it is important to note that meanwhile, ample empirical evidence has been collected in support of Westermarck’s core hypothesis, i.e. that childhood coresidence leads to sexual aversion when reaching sexual maturity. However, before discussing this evidence, we turn to evolutionary psychology, which integrated Westermarck’s hypothesis on incest aversion into full-blown theoretical models on the relation between so-called cues for sibling detection during childhood and sexual aversion in adulthood (section 1.2.1). After discussing the empirical evidence in support of evolutionary psychological accounts on human incest aversion in section 1.2.2, we will return to Westermarck’s hypothesized relation between sexual aversions and moral attitudes (section 1.2.3).

1.2 The evolved psychology of sexual aversion for sex with siblings

1.2.1 Theoretical background

For sexually reproducing animals, reproduction with individuals with a high degree of genetic relatedness is hypothesized to entail a variety of negative outcomes in terms of

the fitness of one's offspring (see e.g., Aberle et al., 1963). In other words, close kin produce offspring of reduced fitness. Such negative outcomes have been extensively documented in captive populations of a variety of species, but is much more difficult to attest in the wild because, on the whole, close relatives rarely breed (Pusey & Wolf, 1996). Although it has been suggested that close inbreeding might not be deleterious to animals which mature quickly and have numerous offspring, it can be expected that many sexually reproducing species will have adaptations (i.e. strategies evolved through the process of natural selection) to avoid sexual contact with close kin (Aberle, 1963). This is based on the logic that individuals that avoid sexual behavior with close kin would have been more reproductively successful (i.e. produce more descendants that survive until adulthood and able to reproduce themselves) than indiscriminate individuals. Indeed, the observation that young male lions leave their group at the age of sexual maturity (sex-biased dispersal) might point to an inbreeding avoidance strategy (for a review of the literature on animal empirical research, see, e.g., Silverman & Bevc 2005). In primates, young male chimpanzees remain in their groups but will avoid mating with their own mothers after reaching sexual maturity (for a review on the literature on inbreeding avoidance strategies in primates, see e.g., Pusey, 2004). Some evolved inbreeding avoidance strategies do not require animals to be able to detect who is genetically related and who is not, but others do. Especially in those cases where close kin tend to remain as part of the same group through adulthood, kin recognition and subsequent sexual avoidance is hypothesized to occur (e.g., Pusey, 2004).²

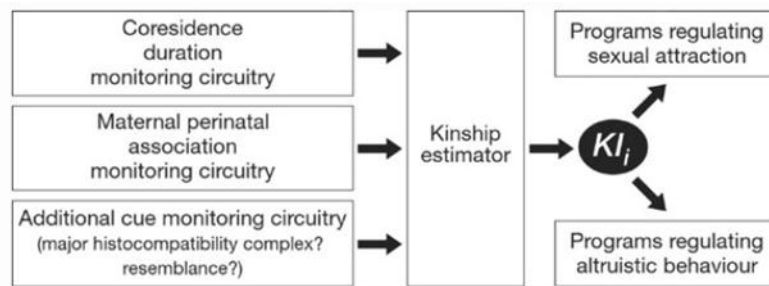
As a side note, while it can be expected that animals have strategies to avoid mating behavior with close kin, it is also very likely that altruistic behaviour will preferentially be directed to related individuals (kin selection theory, see e.g., Hamilton, 1963). In short, genes that encode for altruistic behaviour displayed towards related individuals will more easily spread in the population than genes that encode for altruistic behaviour without discrimination for benefactor's relatedness. Further below, we explain in more detail how cues for kin detection relate to both incest aversion and altruistic behaviour.

The evolutionary principles for the detection of close relatives, in function of sexual avoidance and the display of altruistic behaviour, are also expected to apply to humans. For an overview on the empirical evidence of the harmfulness of incestuous reproduction in humans, we refer to for instance Bittles (2004) or Albrecht & Sieber (2007, p. 112 and further). In short, the empirical evidence regarding the genetic harmfulness of close inbreeding in humans is very limited. This is mainly because close

² Delayed maturation or reproductive suppression have been suggested as additional strategies used when young stay in the same group as their parents (Pusey & Wolf, 1996).

incestuous reproduction (e.g. between brothers and sisters) is extremely rare. Also, it has proven to be difficult to control for confounding variables, such as very young or advanced maternal or paternal ages, parental disease and unsuccessful attempt to interrupt the pregnancy (Bittles, 2004). Nonetheless, the available data indicate a high rate of physical and mental abnormality (Bittles, 2004).

Based on the theoretical background that was already available (e.g. Westermarck's hypothesis), the evolutionary psychologists Lieberman, Tooby and Cosmides (2007) developed a model for the computational architecture for sibling detection, presented in a landmark publication in the scientific journal *Nature* (see figure 1). Following Westermarck, one of the hypothesized cues to implicitly (i.e. at an unconscious level) identify siblings is *coresidence during childhood*. This mechanism had already been hypothesized to be blind to genetics by Westermarck himself: it is supposed to be triggered in both the presence and absence of effective genetic relatedness between co-raised children. A second cue for the detection of siblings is observing one's mother taking care of an infant, as this is indicative for a shared maternal relatedness with that infant. This cue was dubbed *maternal perinatal association*, or shortly, MPA. It was hypothesized that, in order to detect siblings, children cannot but rely on the environmental input that is available to them, but use the information that is most reliable from an evolutionary point of view. According to Lieberman et al. (2007) seeing your mother investing her time and energy in an infant is more direct as a cue than coresidence duration over the entire period of shared parental investment (i.e. mutual childhood). Therefore, it should be expected that coresidence duration is not a relevant predictor of later sexual aversion for those children who experienced MPA with a younger sibling. As the model indicates (see figure 1), the hypothesized role of maternal perinatal association and coresidence duration for the detection of siblings does not exclude that yet other available cues might be relied upon for the inference of genetic relatedness. According to Lieberman, Tooby and Cosmides, a *kinship index* is mentally computed, based on these environmental inputs. The kinship index is subsequently fed into mental programs that regulate sexual attraction and avoidance and the allocation of altruistic behaviour.



Cues to kinship are registered by cue monitoring circuits, which deliver their outputs to a kinship estimator. The kinship estimator uses these cues to compute the magnitude of a regulatory variable—a kinship index—for each individual, i , who is a potential sibling. The kinship index feeds into programs that regulate sibling altruism and sexual aversion.

Figure 1 Lieberman et al.'s (2007) model of the computational architecture of human sibling detection

The sibling detection system has also been integrated into a more extensive evolutionary psychological model presented by Tooby et al. (2008) (see below, figure 2). Similar to Lieberman et al. (2007), the authors started out from the well-known evolutionary psychological hypothesis that the human mind is equipped with internal regulatory variables, which can be accessed by various decision making systems, and ultimately guide behavior regulation and motivation (Tooby et al., 2008). To compute the value of each of these specific internal regulatory variables, the mind relies on circuitry that processes informational input retrieved from, e.g., cues in the environment and previous experience. The internal functioning of these variables and devices mostly happens below the conscious level but they can produce consciously felt experiences, such as emotions or motivations. Their operation highly resembles that of systems designed to regulate physiological processes (e.g. the functioning of organs) (Tooby & Cosmides, 1992). The architecture of each decision-making system depends on the specific adaptive problem it aims to solve, e.g. dealing with the presence of pathogens in the environment. Functionally, it is assumed that the human mind is equipped with all kinds of specialized information processing devices that compute the values of specific internal regulatory variables and combine them, in order to generate output behavior. These systems are hypothesized to be sculpted over evolutionary time, and operate the way they do because they produced behavior that promoted the survival and reproduction of our ancestors better than alternative programs that arised during this human evolutionary history (Tooby & Cosmides, 1992).

The model of Tooby et al. (2008) presents the hypothesized internal functioning of two motivational systems in particular, i.e. the sexual motivation system and the altruistic motivation system. Below we briefly summarize the characteristics of this model, and their relation to the kinship detection system in particular.

The sexual motivation system is assumed to guide efforts related to mating, and produces conscious experiences of variable levels of either sexual attraction or disgust. When a particular person is mentally considered as a potential sexual partner, the

sexual motivational system accesses a particular person's sexual value index, which is a first internal regulatory variable. To calculate the value of this index, a sexual value estimator relies on, e.g. bodily cues that refer to health and fertility, but only when that person's kinship index, a second internal regulatory variable, is sufficiently low. Because of the negative fitness outcomes related to sex with close kin (see above, 1.2.1), the model proposes that a high kinship index will strongly downregulate a particular person's sexual value index.

The altruistic motivation system guides our efforts related to helping and the avoidance of harming, and produces conscious experiences of variable levels of warmth, closeness, and caring. When confronted with the possibility of helping a particular person, the altruistic motivation system accesses that person's welfare tradeoff index. The welfare tradeoff index refers to the amount of weight that is attributed to a particular person's welfare relative to your own. When computing the value of this index, a welfare tradeoff estimator relies on, e.g. cues related to trustworthiness or formidability. Because of kin selection theory (see above), the model proposes that a high kinship index will upregulate a particular person's welfare tradeoff index.

In summary, the value of the kinship index appears to be critical for both the sexual and the altruistic motivation system, as it affects the value of other internal regulatory variables, such as the sexual value index and the welfare tradeoff index. The kinship index is computed by a kinship estimator, relying on cues that correlated with genetic relatedness in the ancestral environment, i.e. for instance childhood coresidence duration and maternal perinatal association for the detection of siblings.

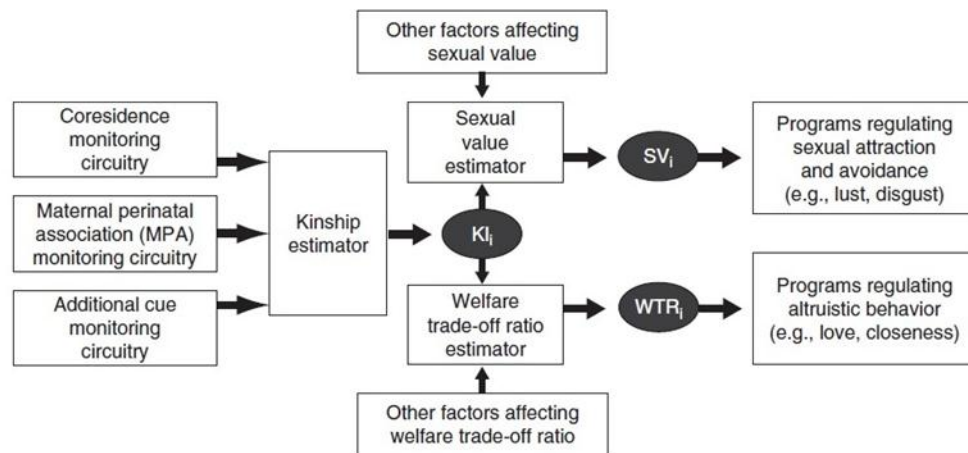


FIGURE 15.1 Model of the human kin detection system, and the internal regulatory variables (black ovals) it computes and regulates. Monitoring circuitry registers cues ancestrally correlated with genetic relatedness (e.g., coresidence duration, MPA). A “kinship estimator” transforms these inputs into a kinship index (KI_i) for each familiar individual i . The kinship index is used by downstream systems to compute two other regulatory variables: a sexual value index (SV_i) and a welfare trade-off ratio index (WTR_i). These serve as input to two motivational systems, one that regulates the allocation of mating effort and another that regulates altruism.

Figure 2 Tooby et al.'s (2008) model of the computational architecture of the sexual and altruistic motivational systems

In addition, following from parental investment theory (Trivers 1972), the sex with the greatest opportunity cost related to reproduction (usually the females) is expected to be more sexually selective. As a consequence, when it comes to humans, women are expected to be more averse to incest than men (Haig, 1999). Also, women could be expected to benefit from a fast and easy detection of opposite-sex relatives, while this would be less imperative to males. In other words, based on parental investment theory, females will potentially compute kinship-relevant information in a more efficient way than males.

1.2.2 Empirical research

While initially have been only one amongst many hypotheses explaining the origins of the incest taboo, the mechanism that was dubbed the Westermarck effect gained increasing empirical support throughout the twentieth and early twenty-first century. The first wave of research consisted of anthropological field studies, while the second included surveys that analyzed subjects' self-reported feelings and attitudes.

1.2.2.1 Field studies

Field research testing for the Westermarck hypothesis often relied on the assumption that, although coresidence duration is usually a reliable indicator of genetic relatedness, deploying this rule of thumb should also bring about, as a side effect, a sexual disinterest amongst genetically unrelated children who grow up together. By typically examining exceptional situations of unrelated children growing up together, these studies demonstrated either an absence of mutual sexual attraction later in life, or – when pressed to marry one another – the presence of lower fertility rates, higher divorce rates or more frequent extramarital relationships.

One of these exceptional situations was found in Taiwan, where, until the mid-twentieth century, young girls were regularly adopted by their future parents in law and raised together with their later husbands. Wolf (1995) showed that these so-called *sim-pua* (or 'little daughters-in-law') marriages typically showed a higher divorce rate, more extramarital relationships and reduced fertility rates, compared to other forms of marital arrangements at that time. Looking at *sim-pua* marriages in specific, Wolf (2004) found that, when the woman was the younger partner, the largest drop in the fertility/divorce index³ can be observed for women who were adopted before the age of

³ Marital fertility was calculated by dividing the number of births among married women aged fifteen to forty-five by the number of years they were married during these ages. Based on this number, a fertility/divorce

three, which was interpreted by the authors as a more outspoken sexual aversion as experienced by the woman in question. The age at first association of the older husband did not matter, as long as the husband was not eight or more years older. In the latter case, the fertility/divorce index was much larger, which is interpreted as a lower sexual aversion. In cases where the woman was the older partner (i.e., she had been adopted before the husband's birth), then her age at adoption did not impact the fertility/divorce index. Here, the husband's first association was obviously at birth, so the effect of husband's age at first association could not be investigated. Thus, Wolf (2004) concluded that he found evidence in females for the existence of a critical period during which coresidence is of special importance. When the female is the younger partner, he hypothesized, the association during the first three years of her life seems to be of particular importance. We will come back to these findings in the next section (see Lieberman, 2009).

Further empirical support for the Westermarck effect was found in Israeli kibbutzim. Although marriages between co-raised genetically unrelated children were not explicitly forbidden, these almost never took place (Shepher, 1971). While generally interpreted as being evidence in support of the Westermarck hypothesis, Shor and Simchai (2009) have contested that coresidence duration was solely responsible for the absence of marriages. According to these authors, sexual attraction and aversion should not be analyzed through the presence or absence of marriages, but instead by probing the feelings of the people who grew up in these peer groups. Based on in-depth interviews with such individuals, they concluded that sociological factors provide an additional explanation for the absence of sexual relationships. One of these suggested sociological factors was group cohesion. It was empirically shown that group cohesion in cohorts of co-raised children would be positively associated with less mutual sexual attraction later on in life. According to the authors this is due to the fact that the development of dyadic romantic relationships might have been perceived as endangering the group unity. Later on, questionnaire-based research of Lieberman & Lobel (2012) however confirmed that in male subjects the duration of coresidence with female peers in Israeli kibbutzim was again a significant positive predictor of self-reported sexual aversion. In female subjects, the opposite pattern was found (i.e. increasing sexual attraction with longer coresidence), which according to the authors may have been due to a ceiling effect in females' responses (see also further below, section 1.4).

index was calculated which adjusted marital fertility by taking into account the number of divorces experienced by these women. The adjustment consisted of a subtraction of five births for every divorce (with 5 as an arbitrarily chosen number) (Wolf, 2004).

Yet another field study was conducted in Lebanon, which indicated that marriages between co-raised cousins were characterized by higher divorce rates and less offspring (McCabe, 1983). More recently, analyses on anthropological data from the North Sumatran Karo Batak revealed that the rare occurrence of matrilinear cross cousin marriages, despite culturally being considered as ideal, can partly be explained by the operation of the Westermarck effect (Kushnick and Fessler, 2011).

1.2.2.2 Survey studies

About a decade ago, a second wave of research emerged, characterized by survey-based studies. These came to be regarded as a key method for testing the Westermarck hypothesis in larger populations. Bevc and Silverman (1993, 2000), the first to rely on surveys, showed that separation from an opposite-sex sibling during early childhood was linked to an increased chance of having consensual sexual experiences with that opposite-sex sibling in adulthood.

It was waiting, however, for the two landmark publications of Lieberman and colleagues (2003, 2007) to arrive at convincing empirical evidence for Westermarck's hypothesis in larger populations. These authors provided both a theoretical and empirical boost to the study of the evolutionary basis of human incest avoidance. The first of the two publications indicated that childhood coresidence duration with opposite-sex siblings was positively associated with moral rejection of consensual third-party sibling incest (Lieberman et al., 2003). This effect did not depend on presence of genetic relatedness with opposite-sex siblings (e.g., full vs. stepsiblings) and was present in both males and females. Around the same time, Fessler & Navarrete (2004) reported that third-party sibling incest aversion (measured as self-reported avoidance, disgust and punitive inclinations towards siblings that have consensual sex) is higher when subjects had an opposite-sex sibling.

Shortly thereafter, Lieberman and colleagues (2007) published a theoretical model for the computational architecture of human sibling detection (presented in figure 1, see section 1.2.1) in *Nature*, along with convincing evidence. They first demonstrated that coresidence duration with an opposite-sex sibling is positively associated with self-reported sexual aversion when imagining sex with that particular opposite sex sibling. This effect, however, could only be tested in males, since data of females were subject to ceiling effects (see also further below, section 1.4). Secondly, for both males and females, it was shown that childhood coresidence duration (with either a same sex or an opposite sex sibling) was positively associated with self-reported measures of altruism displayed towards that particular sibling. Again, all effects were found to be independent of degree of genetic relatedness with one's sibling.

Lieberman et al. (2007) were also able to collect empirical evidence for an additional cue for sibling detection, i.e. witnessing one's mother taking care of an infant child or,

for short, maternal perinatal association (MPA). It was revealed that only in case a subject (male or female) did not experience MPA, coresidence duration significantly predicted sibling-directed altruism, personal sexual aversion for an opposite-sex sibling and moral rejection of incest. A re-analysis of the data on Taiwanese *sim-pua* marriages (see Wolf, 1995, 2004, also discussed above, section 1.2.2.1) confirmed the importance of the MPA cue (Lieberman, 2009). Revisiting Wolf's data, Lieberman (2009) found that a younger age at first association predicted lower fertility rates in the younger partner, but not in the older partner. Therefore, the hypothesized critical period of three years after birth in younger females (Wolf, 1995, 2004) might potentially be explained by a longer total coresidence duration in such women (Lieberman, 2009). The reason that Wolf did not attest a similar critical period for the older partner is probably because in those cases MPA and not coresidence is mainly at work, and age at which MPA is experienced is expected to be irrelevant (Lieberman, 2009).

Nonetheless, using survey studies, researchers have collected limited additional evidence that coresidence during mutual early childhood might be of special relevance. Luo (2011) hypothesized that, if there was a sensitive periode for coresidence, it should not matter for subjects who experienced MPA with a younger opposite-sex sibling. These subjects should rely on MPA, for which age difference is not expected to matter. Indeed, self-reported aversion towards consensual sex between adult siblings did not differ between MPA present subjects with smaller and larger disparity in age with their opposite-sex sibling. On the contrary, there was a significant effect of age disparity on incest aversion for MPA absent males. When age difference was smaller than three years, aversion to sibling incest was greater, even when controlling for total duration of coresidence. Thus, males who did not experience MPA with an opposite-sex sibling displayed larger incest aversion if they co-habited with their sister during mutual early childhood. For MPA absent females, age disparity was again not associated with incest aversion. Earlier, Fessler and Navarrete (2004) had also found that in male subjects, a smaller age difference with a sister was related to stronger aversion for incest. The authors however did not report on separate analyses for males with an older sister (most often MPA absent) and males with a younger sister (most often MPA present). Also, smaller age difference might have been associated with larger total coresidence duration, data on which was not reported.

Additionally, survey research was able to confirm predicted gender differences in self-reported incest aversion. This was attested in several of the studies that we described above (e.g., Fessler & Navarrete, 2004, Lieberman et al., 2007; Lieberman & Lobel, 2012), but also in other research. Using interviews to probe the value of opposite-sex cousins as marriage partners in young adults in Morocco, it was found that, for instance, females evaluated these as less favorable than males (marginally significant difference, $p = .08$) (Walter, 1997). More recent investigations by Antfolk et al. (2012a and 2012b) showed that women, compared to men, display higher levels of self-reported

disgust towards incestuous behaviours between all kinds of related individuals (e.g. sex between siblings, half-siblings and cousins), regardless of self-involvement. Limited evidence is also available for the hypothesis that females are potentially more efficient at picking up kinship information than males: Lieberman et al. (2003) reported that post-pubertal coresidence duration with opposite-sex siblings was relevant for males' incest aversion, but not for females'. Also, Fessler and Navarrete (2004) found that having several opposite sex siblings added to self-reported disgust towards sibling incest in males, but did not have additional effects in females.

1.2.2.3 Additional mechanisms for sibling detection

Besides collecting evidence for sibling detection mechanisms that rely on contextual information (i.e., the Westermarck hypothesis and MPA), researchers have also tested the possible relevance of cues that point at phenotypic resemblance. Such mechanisms make use of physical cues, such as olfactory, acoustic, or visual similarity to self or kin (DeBruine et al., 2011).

Indeed, facial resemblance with close kin for instance, has been linked to altruism and sexual aversion. Lewis (2011), for instance, reported that full siblings higher in facial resemblance reported more closeness and mutual altruism. These effects did not interact with siblings' coresidence duration nor with maternal perinatal association. In addition, olfactory cues might also be of importance. In order to investigate the potential effects of scent, preadolescent children were asked to smell and discriminate a t-shirt worn by a sibling from a t-shirt worn by a stranger, matched to the sibling in age (Weisfeld et al. 2003). In a first study, it was shown that children were able to discriminate the t-shirt of a full sibling, but not from a half- or stepsibling. In a second study, children could recognize their opposite-sex siblings' t-shirts but not those of same-sex siblings. Moreover, children preferred the odor of the control-child over the odor of their opposite-sex sibling.

A whole body of research investigated the impact of facial resemblance on prosocial behaviour and sexual attraction towards *unfamiliar* individuals. In response to, for instance, the faces of strangers that have been morphed to make them more self-resembling to the subject, research has variably attested an increased sexual attraction (Fraley & Marks, 2010), a decreased sexual attraction (Debruine, 2005), or no effect on sexual attraction (Marcinkowska et al., 2013). Indeed, facial similarity might be indicative for degree of genetic relatedness to unfamiliar individuals. However, it has been argued that essentially this research learns us about what factors predict varying degrees of sexual attraction towards unfamiliar individuals (e.g., potentially influenced

by optimal outbreeding⁴, Bateson, 1983), but not about the factors predicting sexual aversion towards close kin, which are individuals we have long been familiar with (Lieberman et al., 2011).

Although the role of phenotypic resemblance is certainly worth further inquiry, this was not the focus of our current investigations. Instead we shall focus on those cues for sibling detection for which most evidence has been collected so far, i.e. coresidence during mutual childhood and maternal perinatal association.

1.2.3 The relation between sexual aversions, moral attitudes and the origins of the incest taboo

According to Westermarck (1891), the cultural incest taboo originates with sexual aversions that spontaneously develop between persons who closely lived together during childhood. These “exogamous rules, though in the first place associated with kinship because near relatives normally live together, have come to include relatives who do not live together” (Westermarck, 1891, p. 214). The bearing of a common name could have had a great influence in this process (ibidem), but, as suggested by Westermarck (1891, p. 215), “generally speaking, the feeling that two persons are intimately connected in some way or the other may, through an association of ideas and feelings, give rise to the notion that marriage or sexual intercourse between them is improper or incestuous”. In other words, the presence of social intimacy is enough for cultural sexual restrictions to be applied between people. According to Westermarck, this is still in accordance with the hypothesis that such restrictions originally trace back to sexual aversions that spontaneously develop between individuals that grow up in close intimacy. Taken together, Westermarck’s original hypothesis stated that moral opposition against incest as well as the cultural incest taboo directly stem from our personal sexual aversions.

Empirical tests for this aspect of Westermarck’s hypothesis have long been absent in the literature (Durham, 2004). During the last decade, however, several studies have provided evidence that suggests that – at least – individual moral attitudes are partly the byproduct of personal sexual aversions. First of all, and importantly, evolved cues for sibling detection do not only seem to predict the strength of sibling-directed altruism and self-reported aversion towards engaging in sexual behaviour with a sibling, but also the strength of disgust for and moral condemnation of an incestuous act

⁴ Optimal outbreeding asserts that humans, and other animals, are expected to unconsciously choose mates who are a bit different from themselves, but not too different. This has been linked to expected fitness costs of excessive outbreeding (Bateson, 1983).

performed by others (e.g., Lieberman et al., 2003). Specifically, the moral rejection of incestuous behaviour in others would be the result of an empathic disgust response (Lieberman et al., 2003). When asked to make moral judgements about incestuous behaviour of others, people purportedly react with a disgust response that resembles how it would feel for themselves to be in that situation. Correspondingly, Lieberman & Lobel's (2012) attested that coresidence duration with opposite-sex peers in Israeli kibbutzim is positively associated with moral rejection of sex between other co-raised peers but not with moral rejection of sex between siblings. Interestingly, Antfolk et al. (2012b) found that self-reported disgust towards incestuous sex between two individuals who are genetically related to the subject is higher than self-reported disgust towards incestuous sex between two individuals who are not genetically related to the subject. Potentially we may feel more motivated to interfere with incestuous sex by people who are genetically related to ourselves due to the principle of inclusive fitness, which predicts that inbreeding in close family members also affects our own fitness (Antfolk et al., 2012b). Alternatively, we may also feel more motivated to interfere with incestuous behaviour of family members, because moral condemnation from the social environment could also potentially befall ourselves. In any case, although the moral rejection of incest might be influenced by how it would feel for ourselves to behave in such way, we are also not indiscriminating about who actually performs the behaviour.

Fessler and Navarrete (2004) explicitly argued that the moral rejection of sex between close kin is partly a byproduct of self-regulation, nevertheless also recognizing the role of culturally transmitted rules for individual moral attitude formation. Their assertion was supported by empirical evidence indicating that self-reported disgust towards sibling incest was not only significantly related to having an opposite-sex sibling, but also to subjects' general attitudes towards autonomy, sexuality, and crime and punishment (Fessler & Navarrete, 2004).⁵ They also formulated an interesting hypothesis with respect to the question of why natural selection did not eliminate such a potentially costly side-effect of self-regulation. As argued, egocentric empathy might most likely be at work when other individuals engage in contaminating or dangerous activities, since such types of acts can also be expected to bring along costs to bystanders. In such cases, the costs of interfering with others' actions might have outweighed the costs of passive observation. Given that sexual disgust is a potential exaptation of earlier evolved pathogen disgust, it might not have been possible for

⁵ In contrast, Lieberman et al. (2003) reported an absence of significant association between moral opposition against sibling incest and subjects' general attitudes towards sexuality or perceived parental attitudes towards sexuality.

natural selection to dissociate egocentric empathy from sexual disgust (Fessler & Navarrete, 2004).

Royzman et al. (2008) explicitly disagree with the byproduct of self-regulation hypothesis. Although the authors acknowledge that humans might display a spontaneous aversion to sex with those they have grown up with, they argue that moral attitudes need a different kind of explanation. According to them, moral opposition against consensual incest is instigated by cultural proscriptions. Following this so-called moral dyspepsia hypothesis, the disgust response is a direct result of the moral judgement itself, and not a 'pre-moral sentiment' that is activated when contemplating about personally engaging in incestuous behaviour during moral decision making. Royzman et al. (2008) support this claim by reporting no significant differences between subjects with and without an opposite-sex sibling when it comes to self-reported disgust responses towards and moral opposition against consensual sibling incest. Nonetheless, still according to Royzman et al. (2008), this is what one would expect if the empathic disgust hypothesis holds true, since subjects without opposite-sex siblings would have to imagine having sex with a fictitious opposite-sex sibling, which is presumably more difficult and is supposed to evoke less disgust since it cannot be subject to the influence of kin detection cues. We will briefly return to these empirical findings in the concluding section of this part.

Of course, even if moral attitudes would in part turn out to be the byproduct of self-regulation, this would not necessarily mean that the cultural incest taboo is also subject to this byproduct hypothesis. As far as we know, there is currently no systematic evidence at hand in support of Westermarck's explanation for the existence of incest taboos. In the meanwhile, additional hypotheses for explaining the origins of the cultural taboo on incest have been formulated. As the reader will notice, most of them assume the presence of psychological mechanisms for incest avoidance between close kin.

Parker (1976) stated that the incest taboo is rooted in innate psychological mechanisms to avoid sexual contact with close kin.⁶ Subsequently, "the progressive evolution of human society and culture made this tendency advantageous for a distinctive set of emergent reasons" (Parker, 1976, p. 294). Innate psychological mechanisms for incest aversion were a facilitating condition for the incest taboo to emerge. According to Parker (1976, p. 290), "as the cultural way of life became established, additional adaptive pressures arose for this biopsychological tendency to become institutionalized as the incest taboo, because it increased the stability of the family unit, assured wider social alliances, and reduced the number of births to

⁶ Parker (1976) links the lack of sexual interest in co-raised siblings to the idea of stimulus saturation.

economically immature individuals.” In other words, the incest taboo needs to be explained by a mixture of alliance theory (Lévi-Strauss, 1948, see section 1.1) and functionalism (Malinowski, 1927, see also section 1.1).

According to Van den Berghe (1980), however, the incest taboo is fundamentally different from rules for exogamy. The former delineates sexual behaviour between close kin and can be adequately explained as being a consequence of human inbreeding avoidance (cf. the Westermarck hypothesis), while the latter allude to marriage between corporate descent groups (lineages or clans) and can be adequately explained by alliance theory (e.g., Lévi-Strauss, 1948, see section 1.1). Still according to Van den Berghe (1980), while incest prohibitions aim to avoid inbreeding, rules on exogamy often strive to limit the amount of outbreeding, by e.g. favouring cross-cousin marriages. As such, marriages within larger kinship networks foster kin selection (Van den Berghe, 1980).

Thornhill (1991) breaks up the incest taboo into three different categories. The first category refers to incest between the closest of genetic kin (e.g., parents and their children, siblings), the second category refers to incest between somewhat more distant genetic kin (e.g. cousins) while the third category refers to incest between individuals in an affinal relationship (i.e., kin by marriage). Using data from 129 societies across the world, Thornhill (1991) presents evidence that cultural rules on incestuous behaviour focus on the latter two categories (with 88% of individual societies including explicit rules on these categories of incest) and much less on the first one (with 44% of individual societies including explicit rules on this category of incest). As for instance the second category (e.g. cousin marriage) may be used as a strategy to accumulate wealth, it is hypothesized that societies’ leaders are in general much more inclined to make a taboo out of this type of incest (because it runs against their own interests) than with incest between closest of kin, which is already spontaneously absent due to psychological mechanisms for inbreeding avoidance (Thornhill, 1991).

Aoki and Feldman (1997) developed a gene-culture coevolutionary model for explaining the presence of the cultural incest taboo. This model rests on the assumption that the detrimental effects of close inbreeding need to be sufficiently high, i.e. an estimated inability to reproduce in 33% of siblings’ offspring. This estimation however does not fall outside of the range of the actual numbers, according to the authors. The model indicates that in this case, a cultural taboo may evolve even in the absence of innate tendencies to avoid sexual contact with close kin. Their model is built on the detrimental effects of inbreeding and the vertical cultural transmission (parent-child) of

a norm to choose or not to choose one's sibling as a reproductive partner.⁷ It explains the presence of the incest taboo as a cultural norm in response to the detrimental effects of inbreeding, making the innate aversion hypothesis superfluous. However, ever since this model was published, additional evidence has been gathered that supports the existence of innate tendencies to avoid sexual contact with close kin (see section 1.2.2).

Durham (2004), building on the arguments by Morgan (1877) and Burton (1973), posits that the incest taboo emerged as a consequence of the observation of the negative outcomes of inbreeding. Although the Westermarck effect entails that inbreeding amongst the closest relatives is generally avoided, it cannot prevent sexual attraction to occur between more distant relatives, such as cousins. Therefore, local people would come to recognize the abnormal consequences of such inbred unions (which does not require a Western scientific understanding of their genetic causes). These abnormalities are subsequently interpreted as harmful and potentially threatening to everyone (at this point, Burton (1973) added an element of fear for divine punishment, which was omitted by Durham (2004)). In response to such harm or threat, societies institutionalize their avoidance of such deleterious unions in the form of the cultural incest taboo.

Models that refuse to accept any kind of biological basis of human incest avoidance still continue to exist, but are more limited in number. Leavitt (2013, p. 49) for instance asserts that there are insufficient reasons to accept Westermarck's hypothesis when explaining personal sexual aversions for incest. The author however is not exactly fair to Westermarck's Darwinian account, since he only mentions the presence of Wolf's (1995) and Shepherd's (1971) field studies in support of it. Instead he relies on alliance theory to explain the existence of the incest taboos (e.g., Lévi-Strauss, 1948, see section 1.1).

Thus far, we are still far away removed from conclusive evidence for any single hypothesis that aims to explain the origin(s?) of the cultural rule itself. Some authors recognize that a number of historical scenarios are possible, and believe that it will remain difficult to get clarity or definitive answers when dealing with questions of origin (e.g. Durham, 2004).

When it comes to individual moral judgments, there is evidence at hand, though all in all still in a fairly limited amount, that these are the result of an empathic disgust response (Lieberman et al., 2003; Fessler & Navarrete, 2004; but see Royzman et al., 2008). This view is based on individual moral decision making, not on the cultural taboo itself. Thus, the empathic disgust response hypothesis is perfectly tenable, while

⁷ What might actually be vertically transmitted are for instance economic circumstances that favour sexual reproduction with siblings, as argued by Feldman and Aoki (1997).

acknowledging that the origin(s) of the cultural incest taboo requires its own specific explanation(s). It also does not imply that the incest taboo lacks any functional properties in society. However, the empathic disgust response may be the psychological force behind cultural incest taboos, and may help improve our understanding of why incest taboos emerged cross-culturally and have been sustained over time. Indeed, “it is important to recognize the way in which the incest taboo has surfaced and resurfaced over time in particular social contexts as one of the many vehicles through which the state has controlled sexuality and the constitution of the family” (Cahill, 2005, p. 1609). One of the merits of the empathic disgust response hypothesis is that it accounts for the fact that prohibitions against incest seem to be ‘natural’ from a psychological point of view, meaning that these are easily acquired and very intuitively appealing (cf. Boyer & Petersen, 2011). As this part of the dissertation concentrates on the aversion of having sex with a sibling of our own, and not on moral judgements, we will let this issue rest for now. However, we shall revisit it in part 2, where our focus lies with the incest taboo and moral decision making.

1.3 Disgust as an embodied experience

Up until now, empirical research testing for predictions stemming from evolutionary psychology to explain the mechanisms that drive the sexually aversive response to incest mainly made use of self-report measures of attitudes and emotions. We know of only one study which investigated neural activity when thinking of incestuous acts (Schaich Borg et al., 2008). This fMRI study included men only, and consisted of a memorization task involving sentences that describe acts performed in person. It was shown that, when contrasted with neutral acts (e.g., ‘you holding your sister’s groceries’) similar brain regions are active when thinking about incestuous acts (e.g., ‘you watch your sister masturbate’), non-sexual immoral acts (e.g., ‘you killing your sister’s child’) and pathogen disgust-related acts (e.g., ‘you sipping your sister’s urine). On the other hand, some brain regions were more active and others were uniquely active when processing pathogen acts compared to socio-moral acts (i.e., the incest and non-sexual immoral acts combined), and vice versa. Interestingly, although the incest acts were judged to be equally disgusting as the pathogen acts and equally immoral as the non-sexual immoral acts, the incest condition showed to generate a much more powerful response by activating almost the entire brain.

Besides responses in the brain, the experience of disgust involves additional verbalized, physiological and behavioural dimensions (see, e.g., Rozin et al., 1999a). Cacioppo et al. (1997, p. 27) described the experience of emotions in general as involving

“cognitions (e.g. feelings, memories, appraisals); visceral, humoral, and immunological reactions; gestures, vocalizations, and expressive displays; postural orientations and overt behaviors; or varying combinations of these”. Although these outcomes may be the products of separate physiological systems, all are related to the emotional experience as a central state (Vrana, 1993). In other words, self-reported subjective feelings merely represent one component of an emotional response. According to Vrana (1993), researchers have often put primacy on this self-experienced, affective, component of emotion. Nonetheless, in order to obtain a complete view on emotion, it may indeed be interesting to take a look at other aspects of emotional phenomena. Below, we briefly report on the methodological and empirical accomplishments regarding the assessment of the facially expressive and other physiological dimensions of disgust.

1.3.1 The facial disgust expression

Darwin (1872) acknowledged the diverse behavioural and physiological components involved during emotional experience, and believed that our most important emotions are expressed cross-culturally, and in the same manner. He described the facial expression of disgust as follows:

“The nose may be slightly turned up, which apparently follows from the turning up of the upper lip; or the movement may be abbreviated into the mere wrinkling of the nose. The nose is often slightly contracted, so as partly to close the passage and this is commonly accompanied by a slight snort or expiration.” (Darwin, 1872, pp. 255-256)

“it is generally accompanied by a frown” (ibidem, p. 258)

“With respect to the face, moderate disgust is exhibited in various ways; by the mouth being widely opened, as if to let an offensive morsel drop out; by spitting; by blowing out of the protruded lips; or by a sound as of clearing the throat. Such guttural sounds are written ach or ugh; and their utterance is sometimes accompanied by a shudder, the arms being pressed close to the sides and the shoulders raised in the same manner as when horror is experienced. Extreme disgust is expressed by movements round the mouth identical with those preparatory to the act of vomiting. The mouth is opened widely, with the upper lip strongly retracted, which wrinkles the sides of the nose, and with the lower lip protruded and everted as much as possible. This latter movement requires the contraction of the muscles which draw downwards the corners of the mouth.” (ibidem, pp. 258-259)

Rozin et al. (2000) provided the following overview of facial movements linked to the expression of disgust, largely overlapping with Darwin's (1872) description: gape, retraction of the upper lip, raising of the lower lip, nose wrinkle and dropping of the mouth corners. Observing the totality of these expressive components, "it is clear [...] that activity centers around the mouth and nose, and that the movements tend either to discourage entry into the body (e.g. nose wrinkle, lower lip raise) or to encourage discharge (gape with or without tongue extension)" (Rozin et al., 2000, p. 639). The disgust facial expression is now widely recognized as one of the six basic emotional expressions that have been shown to be universal in performance and perception (Ekman & Keltner, 1997).

Not surprisingly, many methods have been developed that aim to reliably assess facial expressions of emotions (see for instance Ekman, 1982). A large amount of these involve observers who rate the, e.g. videotaped, facial expressions of other individuals. These techniques can be classified into two methodological approaches, dubbed as the *message judgment* approach and the *measurement of sign vehicles* approach (Ekman, 1982). In the first approach, observers focus on making inferences about the specific mood or emotion that is underlying the expression. In the second approach, observers instead concentrate on merely describing the movements of the face. In a substantial review, Ekman (1982) discusses a non-exhaustive list of 14 techniques for measuring facial actions using observers that either make inferences about the expressions, merely describe them, or do both. Disadvantages of such methods are that they are observer dependent and labour intensive. Therefore, more recently, automated forms of such coding systems, using optical flow analysis⁸, have been developed as well (see, e.g., Cohn et al., 1999).

Facial electromyography is yet another technique for assessing facial expression, not centered around observers' judgement. This method involves the placement of small electrodes (with a typical size of about Ø 3 mm) on designated areas of the face. Essentially, during muscle contraction, these electrodes pick up voltage fluctuations due to changes in the electromagnetic field generated by the contraction, which is passed through extracellular fluids to the skin (see Tassinari et al., 2000 for a detailed description on the technical functioning of facial electromyography). So, facial electromyography does not directly register muscle 'movement' itself, but rather the electric activity associated with these events. As a result, facial electromyography is

⁸ Optical flow analysis is "based on the assumption that muscle contraction causes deformation of overlying skin. In a digitized image sequence, algorithms for optical flow extract motion from the subtle texture changes in skin, and the pattern of such movement may be used to discriminate facial displays. Specifically, the velocity and direction of pixel movement across the entire face or within windows selected to cover certain facial regions are computed between successive frames." (Cohn et al., 1999, p. 36)

often expressed in Volts, most often in units of microVolts (μV) (Fridlund & Cacioppo, 1986).

A landmark study in the development of electromyographic research on disgust was published by Vrana in 1993. As indicated by the author, in comparison to observational studies, this method has the benefit of being able to *sensitively* assess the activity in facial muscles. Building further on earlier work in facial electromyography⁹, Vrana (1993) developed a method to assess the facial electromyographic activity for specific so-called negative emotions, focusing on anger and disgust. The *levator labii (superioris and alaeque nasi)* (see figure 3), involved in raising the upper lip and wrinkling the nose, were assumed to be distinctively active during the facial expression of disgust. Based on earlier research (e.g. Dimberg, 1990), it was also expected that disgust, as a negative emotion, would elicit activity in the *corrugator supercillii* region but not in the *zygomaticus major* region (see also figure 3). During the experiment, subjects, guided by written instructions, were asked to vividly imagine situations eliciting either joy, pleasure anger or disgust. During disgust eliciting trials, Vrana (1993) picked up activity in the *corrugator* region (active when frowning) to an equal extent as anger eliciting trials, and activity in the *levator labii* region to an equal extent as the joy eliciting trials. The activity in the *levator labii* region during the joy trials was explained to be due to cross-talk of activity in the *zygomaticus* region (active when smiling). Later on, Yartz and Hawk (2002) also demonstrated that the *levator labii* region is selectively active when images are displayed that typically elicit disgust (e.g. mutilation, cockroaches and dirty toilets), in comparison to images that display fearful situations (e.g. car accidents and threats of interpersonal violence). In sum, electrode placement in the *levator labii* region is selective for the experience of disgust, in comparison to the experience of anger, pleasantness and fear, but not in comparison to the experience of joy. The issue of distinguishing joy and disgust from electromyographic signals will receive additional attention in the following paragraphs.

Fridlund and Cacioppo (1986) and Tassinari et al. (2000) developed standard guidelines for facial electromyography research involving a broad array of facial emotional expressions.¹⁰ Apart from discussing the history and development of devices to measure muscle contractions, Tassinari et al. (2000) discuss typical issues involved in

⁹ Earlier research in facial EMG had for instance already discovered how to differentiate, through fEMG signals, the experience of pleasant and unpleasant emotions, through activity in respectively, the *zygomaticus major* region (active when smiling) and the *corrugator supercillii* region (active when frowning) (see also figure 3).

¹⁰ These guidelines include for instance information on electrode site specification, appropriate site preparation before electrode placement, noise reduction, and signal processing (e.g. amplification and filtering).

research that involves facial electromyography. We will discuss these briefly, as they are important to be kept in mind throughout the chapters of this dissertation featuring facial electromyography (i.e. chapters 2, 3 and 4).

A first issue is that the relatively limited amount of facial muscles in the head and face are responsible for the encoding for up to 7000 appearance changes (Tassinari et al., 2000). Therefore, monitoring activity from a single site may only provide general or ambiguous information about the processes that are going on. However, as we discussed above, activity in the *levator labii* has been shown to be typical for the facial expression of disgust (Vrana, 1993), resolving any purported lack of discrimination ability.

More important however, is the imperfect signal selectivity of facial electrodes, due to the close proximity of various facial muscles, which may additionally impede the interpretation of facial electromyographic activity. This is similar to what we discussed above, with relation to cross-talk activity in the *levator labii* and *zygomaticus major* regions. A remedy to this issue could be to measure electromyographic activity in several facial regions during one single experiment. For instance, in case of disgust, by measuring activity in both the *levator labii* region and the *corrugator supercilli* region. High activity in both muscles would allow reliably discriminating expressions of disgust from expressions of joy.

However, this remedy directly affects another issue in electromyography research: the presence of facial electrodes may be experienced as obtrusive, and hinder facial expression by making subjects too tense or self-conscious. Therefore, if the experimental design already expects to elicit disgust instead of joy (as can be expected when healthy subjects are asked to imagine sexual contact with a close family member, see chapters 2 and 3), we judged it to be appropriate to solely measure electromyographic activity in the *levator labii* regions as a discriminator of disgust. At the same time this limited the number of electrodes attached to the subject's face during the experimental procedure.

Apart from these limitations, Tassinari et al. (2000) also identified several benefits held by electromyography as a technique for measuring facial expression. For instance, in contrast to self-reports, it allows continuous data collection without demanding the individual's specific attention to the measurement procedure. In comparison to techniques that put observer ratings central (*message judgment* and *measurement of sign vehicles* approaches, as described by Ekman, 1982), it allows fine-grain analyses of subtle processes that may be going on without the human eye being able to detect visible movements. Therefore, it is a technique that is worthwhile including complementary to other measures that assess the different dimensions of experienced emotion.

As a result, research over the past 15 years has increasingly turned to facial electromyography to gauge facial expressive responses to typical disgust elicitors. An important part of this research has focused on mapping the relation between facial expressive responses, other physiological variables (see below), affective ratings and

general disgust sensitivity. Below, we illustrate this point by looking at some of these studies in more detail.

Early on, Stark et al. (1998) showed participants images of typical disgust-elicitors (e.g. spoiled food, excrements, blood) along with neutral images. Each image was observed for 8 seconds, along with the registration of EMG-activity in the *levator labii* region, heart rate and skin conductance response (see below for further information on these physiological measures). After this, subjects viewed the images for a second time, and rated these on valence, arousal, dominance and disgust. When comparing self-report scales and physiological outcomes, highest correlations were found between fEMG activity and self-reported disgust towards the specific images (Pearson's $r = .70$). Schienle et al. (2001) reported data, including female subjects only, which showed that individuals high in disgust sensitivity (measured using a self-report disgust sensitivity scale, developed by Haidt et al., 1994) displayed stronger fEMG activity in the *levator labii* region in response to images showing disgusting scenes.

Stark et al. (2005), on the other hand, who included both men and women in their subject sample, did not find any significant association between fEMG responses and self-reported levels of disgust towards images displaying e.g. decayed food. Disgust sensitivity (measured using the disgust sensitivity scale of Haidt et al., 1994) correlated with self-reported levels of disgust towards specific images, but not with facial EMG responses in the *levator labii* region. In other words, affective disgust experience (i.e. general disgust sensitivity or ratings of specific items) is not always associated with stronger activity in the *levator labii* region.

Apart from being incorporated in studies that try to obtain a more full-scale picture of disgust (assuming that it consists of affective as well as physiological components), electromyographic measurement of facial disgust has also been applied to acquire a better understanding of the role of disgust in disorders, including vaginismus and dyspareunia (Borg et al., 2010), and phobias, including spider phobia, blood-injury-injection phobia and contamination-related obsessive-compulsive disorder (for an extensive review on facial disgust in relation to these phobias, see Cisler et al., 2009). Interesting as the insights of these empirical studies may be, they are not directly relevant for this introductory section on methodology. Instead, we turn to a concise overview of yet other physical components that might show a specific pattern during the experience of disgust.

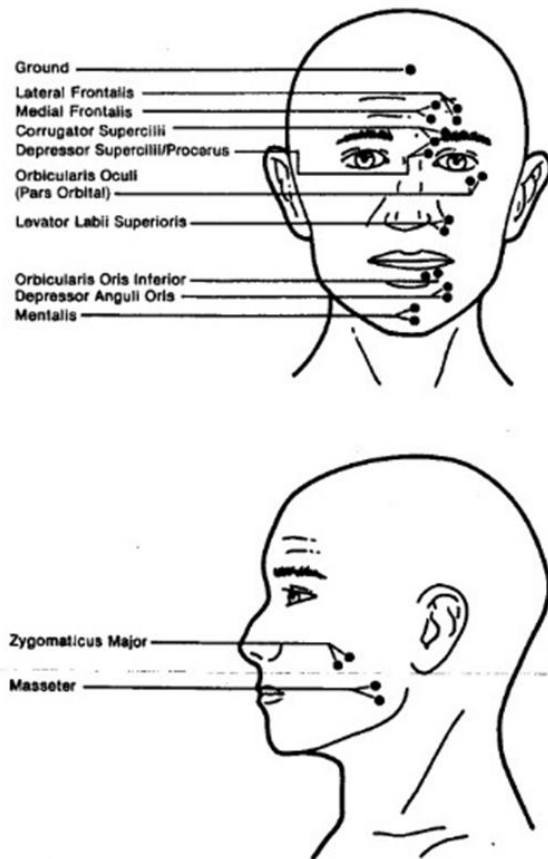


Figure 3 Figure displaying electrode placement for facial electromyography (figure derived from Fridlund & Cacioppo, 1986)

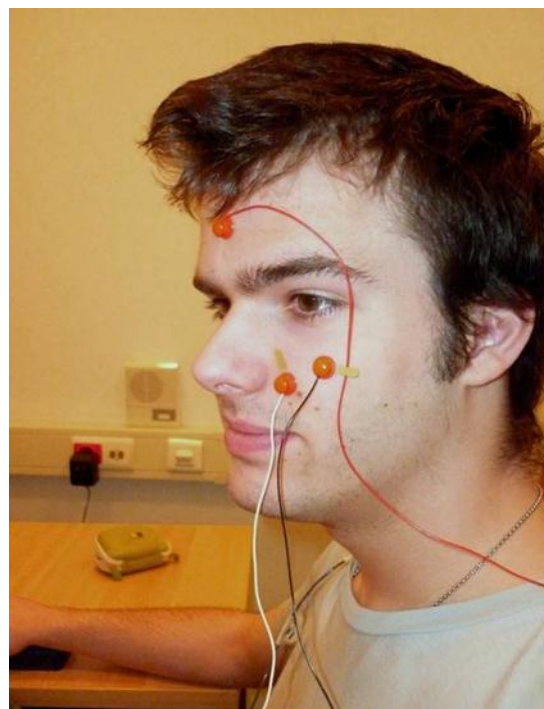


Figure 4 Image showing electrode placement for measurement of facial electromyography in the *levator labii* region

1.3.2 Other physiological responses to disgust stimuli

Research focusing on physiological aspects of the disgust experience have included other bodily parameters, apart from facial expressions. A few studies have taken a look at changes in blood pressure (e.g., Schienle et al., 2001; Rohrmann & Hopp, 2008), while others have included hormonal and immunological changes during the observation of pathogen-related stimuli (e.g., cortisol and immunoglobulin A in Rohrmann et al., 2009; interleukin-6 in Schaller et al., 2010). Schaller (2010) for instance found an increase in white blood cells' production of interleukin-6, an indicator of immunological response, when subjects passively watch images of people displaying characteristic behavioural and morphological signs of infectious disease.

In this brief overview, however, we will concentrate on the parameters for which most empirical evidence is available, i.e. heart rate (HR) and skin conductance response (SCR). Cardiac activity and skin conductance response are physiological parameters which can be used to assess arousal. Early on, it was hypothesized that, while anger and fear would involve sympathetic arousal (i.e., promoting fight-or-flight responses), disgust would mainly be parasympathetically organized (i.e. promoting a physiological rest state) (Rozin et al., 1999a). Following this hypothesis, one would expect to observe no increases in SCR, and a stable or decreasing HR (Rohrmann & Hopp, 2008). However, as will be illustrated in the paragraphs that follow, HR displays a heterogenous pattern in response to disgusting stimuli, SCR most often shows an increase, and both HR and SCR lack a distinctive response pattern for disgust in comparison to other emotions.

Some research attested *heart rate increases* in response to typical disgust-eliciting stimuli. Vrana (1993) observed, in comparison to imagined pleasant situations, a higher heart rate *increase* in response to imagining situations that involve the experience of disgust. This difference was most pronounced during the latter half of an 8 s stimulus presentation window. No differences in HR change were found between situations that elicited disgust, anger or joy. Schienle et al. (2001) reported higher increases in heart rate when observing disgust-eliciting images (e.g. dirty toilet, decaying dog, feces) when compared to observing neutral images (e.g. umbrella), but not when compared to observing pleasant images (e.g. puppies, fireworks).

Other studies however have observed *heart rate decreases* in response to disgust-eliciting stimuli. Stark et al. (2005) observed, in comparison to responses to neutral images, a heart rate deceleration during the second interval of an 8 s time window displaying images that typically elicit disgust (e.g. mutilation, spoiled food). Change in HR significantly correlated with self-reported experienced disgust. Rohrmann et al. (2009) differentiated between individuals high and low in disgust sensitivity, based on a self-rated scale developed by Schienle et al. (2002). Taken together, subjects displayed a lower heart rate when observing a disgust-inducing film clip (amputation procedure) in comparison to observing a neutral film clip (displaying geometric figures) (each film

clip was displayed for about a minute). Overall, no differences in heart rate responses were observed between individuals high and low in disgust sensitivity.

To make the relevance of HR even more questionable, some studies have even observed *stability in heart rate* when observing disgusting stimuli. When Levenson et al. (1990) asked subjects to make the facial expression for disgust (which led to associated affective experiences of disgust), only a very slight increase in heart rate was displayed. This increase was significantly smaller compared to being asked to make the facial expression of anger, fear and sadness.

Cardiac activities have even been shown to differ between disgusting film clips that are making part of the same experimental design. Rohrman and Hopp (2008) reported a lower heart rate in response to a film clip displaying the procedure of an amputation compared to a film clip displaying geometric figures and compared to a film clip displaying a vomiting person (each film clip was displayed for about a minute to all subjects). Nonetheless, the film clip with the vomiting person led to significantly higher degrees of self-reported disgust. Besides heart rate, these authors reported on a range of other cardiovascular parameters, including heart rate variability and stroke volume (the latter indicating the efficiency of the heart). No consistent pattern in total cardiac activity was observed during the disgusting film clips.

In order to assess skin conductance response (SCR), one measures the electrical conductance of the skin, which varies depending on the amount of sweat-induced moisture on the skin. Increased skin conductance (i.e., increased sweat secretion) is generally used as an indication of psychological or physiological arousal. In general, research has reported increases in SCR during the observation of stimuli that evoke disgust, compared to the observation of neutral stimuli. For instance, in comparison to a neutral film (displaying geometric figures), participants displayed a higher increase in skin conductance response when observing films depicting an amputational procedure or a vomiting individual (Rohrman & Hopp, 2008; replicated in Rohrman et al., 2009).

However, the research is inconclusive about whether SCR is a good discriminator for experienced disgust, in comparison to other emotions. Vrana (1993) for example did not report differences in SCR to pleasant, joyful, anger-eliciting or disgust-eliciting imagined situations. Levenson et al. (1990) on the other hand reported significantly higher SCR when subjects were asked to make the facial expression of disgust compared to when being asked to make the facial expressions of happiness or surprise. However, no difference was observed with making the facial expression of fear or sadness. Stark et al. (2005) reported no significant linear association between SCR response and self-reported experienced disgust.

Essentially, although it has been hypothesized that physiological responses to disgust would reflect the activation of the parasympathetic nervous system (i.e. promoting rest state) rather than the activation of the sympathetic nervous system (i.e. promoting fight-or-flight responses), increases in SCR and variable changes in HR (increases,

decreases, or stability) have been observed in response to disgust-evoking stimuli. Moreover, research reveals that heart rate and skin conductance responses do not allow discriminating the experience of disgust from the experience of other emotions.

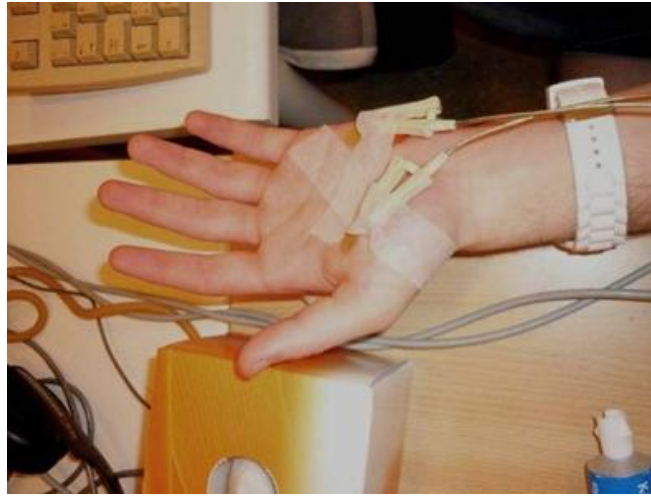


Figure 5 Image showing showing electrode placement for measurement of skin conductance responses

1.3.3 The relation between affective and physiological components of disgust

In the previous sections, we discussed that facial EMG activity in the *levator labii* region is distinctively active (i.e. compared to other emotions) when observing or imagining situations that typically elicit disgust (section 1.3.1). However, research involving HR and SCR showed no clear and distinctive response pattern for disgust, compared to other emotions (section 1.3.2). The latter findings confirm what emotion research has revealed since its inception. As stated by Schachter and Singer (1962, p. 380), “the variety of emotion, mood and feeling states are by no means matched by an equal variance of visceral patterns”.

An important conclusion, based on what we discussed in the previous sections, is that affective and bodily responses do not necessarily operate in synchrony during the experience of disgust. From its very start, it has been a central concern for emotion research to discover how these different dimensions are related to each other (Dimberg, 1990). Several hypotheses have been put forward. Schachter and Singer (1962) for instance argued that the affective self-reported component represents the labelling of an individual based on an experienced state of physiological arousal. Vrana (1993) stated that self-reports reflect semantic judgment of the meaning of the situation, while

physiological expressions (including facial expressions) reflect the fundamental action disposition (avoidance behaviour in case of disgust).

Facial expressions, for their part, have classically been linked to the communicative component of emotional experience in both psychological and anthropological research (see, e.g., Schmidt & Cohn, 2001). Potentially, the disgust facial expression is a social adaptation, i.e. being a signal with a primarily social purpose. If so, and as pointed out by Schmidt & Cohn (2001), the relationship between affective disgust experiences and facial disgust expressions is not directly relevant: they each have an adaptive function on their own. Alternatively, facially displayed disgust, as an outward expression, might also be a byproduct of the affective experience of disgust.

Both of these accounts however do not address the question as to why exactly the facial expression of disgust looks the way it does. Therefore, more recently, both theoretical and empirical work has been carried out that builds on the hypothesis that facial expressions might have adaptive value on their own (an idea originally formulated by Darwin, 1872), besides potentially bearing a derived, i.e. communicative, function. Süsskind et al. (2008) for instance demonstrated that exposure of the sensory surfaces is decreased when the disgust face is made (e.g., decreased visual field size and nasal respiratory capacity). In contrast, the facial expression for fear was shown to be characterized by an enhanced sensory exposure to the environment. As indicated by the authors, these findings suggest that “facial expressions originate in egocentric sensory function rather than allocentric communicative value, indicating that the varieties of facial expression form may be shaped by a common underlying sensory regulatory function” (Süsskind et al., 2008, p. 847).

1.4 An additional methodological avenue for the study of incest aversion

As described above (section 1.3), thinking about incest evokes a very powerful response in the brain, which mirrors the ceiling effects that are often found in self-reported levels of disgust when subjects are asked to imagine having sex with siblings or other close family members (see, e.g., Fessler & Navarrete, 2004; Lieberman, 2007; and Lieberman & Lobel, 2012). Such ceiling effects in self-reports of disgust have also been attested in scenarios describing incestuous sex between people that are genetically related to the subject (Antfolk et al., 2012b).

So, although the use of self-reports has proven to generate many interesting insights for studying the evolutionary psychology of sibling incest aversion (see section 1.2.2.2),

this method tends to be vulnerable to ceiling effects, the presence of which might be due to a combination of genuinely high levels of affectively experienced disgust, and self-presentational strategies that steer subjects' responses to the higher end of the scale. After all, incestuous behaviour has not ceased to be the subject of a strong taboo in current society, which is illustrated for instance by the continued criminalization of consensual sex between adult close kin in many countries (see part 2). This societal taboo makes it highly socially desirable to find incest appalling. If self-presentational strategies are inherent to self-report measures of incest aversion (being almost the single used method), then this might obscure the detection of hypothesized findings¹¹, and even hinder the discovery of additional mechanisms for kin detection.

The study of physiological responses to incest may provide us with an additional, complementary, method for the study of human incest aversion, and this for several reasons. First, the physiological method registers fine-grained responses, with millisecond precision. This allows researchers to go looking for subtle (inter-individual) differences in response patterns. Secondly, although a design that involves physiological measurements might be more expensive and time-consuming than self-report research, it is still much more cost-effective than fMRI brain research for instance. Lastly, psychophysiological responses are immediate and presumably less subject to conscious control than self-reports of subjective inner states. Nonetheless, physiological responses as well might be subject to conscious control strategies (see, e.g., Reynaud et al., 2012). We return to this issue in the concluding section of part 1.

For the reasons described above, we decided to apply the physiological method to the study of human incest aversion. Each of the next three chapters describe an empirical study that involved this approach (SCR, HR and fEMG in ch. 2 and 3; fEMG in ch. 4).

¹¹ Potentially this could explain the lack of a significant association between coresidence duration and disgust towards sibling incest as reported by Royzman et al. (2008).

Chapter 2 In young adult females, childhood coresidence duration with a brother predicts fEMG measured facial disgust to imagined sex with that brother¹

“The movements of expression give vividness and energy to our spoken words. They reveal the thoughts and intentions of others more truly than do words, which may be falsified” (Darwin, 1872, p. 366).

2.1 Introduction

In order to explain the widespread occurrence of incest avoiding behavior, the Finnish anthropologist Edward Westermarck (1891, 1908) theorized that humans spontaneously develop a sexual aversion towards individuals they have lived with during childhood. He believed that natural selection favors such a mechanism as it prevents inbreeding and establishes childhood coresidence as a reliable indicator of biological relatedness. In later research, this hypothesis was dubbed as the Westermarck-hypothesis (WH), and its mechanism the Westermarck-effect (WE).

A century later, Lieberman et al. (2007) uncovered an additional cue for sibling relatedness: witnessing one’s mother taking care of an infant, or, maternal perinatal association (MPA). Through survey research, Lieberman et al. (2007) demonstrated that

¹ This chapter was published earlier in the A1-ranked scientific journal *Evolution and Human Behavior*, see De Smet et al. (2014).

MPA with an opposite-sex sibling predicts self-reported altruistic behavior towards that sibling. Having experienced MPA also increases self-reported moral rejection of consensual third-party sibling incest. Therefore, as empirically demonstrated by the authors as well, coresidence duration appears to be a cue for sibling detection only when MPA is absent.

Notwithstanding the progress made in uncovering sibling detection cues through field and survey research (see section 1.2.2 above), frequent reliance on self-reporting renders incest aversion studies susceptible to certain limitations inherent to the method (cf. Lieberman & Lobel, 2012). Rating and ranking tasks, for instance, are vulnerable to social desirability and ceiling effects. Such methodological limitations may hinder the further refinement of the mechanisms underlying sibling detection. Therefore, we believe that studying the phenomenon, using alternative methods, may be of value to the field. Having done so, we not only aimed to replicate earlier findings, but also to further our scientific knowledge of the psychological basis of human incest aversion.

As discussed in chapter 1, research on (moral) attitudes regarding incest has often focused on emotional responses, in particular self-reported levels of experienced disgust. However, emotional processes are not only characterized by subjective response systems, but also by behavioral and physiological systems (Vrana, 1993). As these systems do not necessarily function in synchrony, physiological response patterns to incest may provide an interesting viewpoint in addition to what people report subjectively. Alongside self-reporting, this makes the psychophysiology method a potentially interesting tool for investigating incest aversion.

In this study, we explore whether this approach can be useful for studying human incest aversion. We designed an experiment in which subjects were instructed to observe pictures of sexual and non-sexual activities and to imagine performing these activities with either their partner or their brother. Meanwhile, heart rate (HR), skin conductance response (SCR) and facial electromyography (EMG) of the *mm. levator labii superioris and alaeque nasi* region were measured with millisecond precision. Questionnaires were used to verify coresidence duration with brother(s) and additional characteristics of brother relation(s), such as genetic relatedness.

As thinking about incest evokes behavioral disgust reactions (Fessler & Navarrete, 2004; Royzman et al., 2008) and activates brain regions that partly overlap with regions that are active while thinking of pathogen disgust (Schaich Borg et al., 2008), we expected our subjects' psychophysiological responses to be comparable to those evoked by other disgust-related items. As the *levator labii* region is activated distinctively by disgust-related images (Vrana, 1993), EMG activity was expected to be a highly relevant psychophysiology measure. According to Rozin et al. (2008), disgust experiences are associated with activation of the parasympathetic nervous system, but empirical research has shown varying responses in HR and SCR to disgust stimuli (e.g. Rohrman et al., 2009; Rohrman & Hopp, 2008; Stark et al., 2005; Schienle et al., 2001). Therefore,

it can be expected that both of these measures will be less discriminating for disgust than EMG. However, as HR and SCR have not previously been reported in the context of imagining incest, we opted to include them in our experimental design.

The psychophysiology method provided us with the opportunity to replicate some well-established findings in the domain of the evolved psychology of incest aversion. As we discussed in section 1.2.1 above, parental investment theory (Trivers, 1972) predicts that incest aversion will be stronger in females. Given the exploratory character of this study, we included female subjects only in this phase, which allowed us to avoid taking into account gender differences. Instead, we completely focussed our attention on the replication of the effects of coresidence duration and MPA on sexual aversions towards siblings. Following the original Westermarck hypothesis, we expected coresidence duration with brothers to be a predictor of psychophysiological responses, in particular fEMG, when women imagine having sex with a brother. Following the Lieberman et al. (2007) model of the computational architecture of sibling detection, we expected coresidence duration with brother(s) to be relevant only among participants who had not experienced MPA.

2.2 Methods

2.2.1 Participants

A total of 77 female students from Ghent University, Belgium, were recruited online to participate in a psychophysiology experiment. Because our experimental set-up required spontaneous reactions to the incest scenarios, the recruitment information did not explicitly state that the experiment was about incest. Instead, students were informed that the experiment involved the observation and rating of potentially disgusting and/or disturbing sexual images and the completion of questionnaires that probed for personal information. Participants were assured in advance that they could stop the experiment at any time. Afterwards, all participants received the contact details of the research leaders and caretakers, which they could contact if they experienced any distress or wished to discuss the experiment. Participants were paid €10 for their full participation. The study had been approved by the UGent Faculty of Psychology and Pedagogical Sciences' Ethical Committee.

2.2.2 Materials

2.2.2.1 Pre-experimental questionnaire

Subjects indicated their age, sexual orientation, relationship status, and for each brother: age, biological relatedness (full or half-brother or no genetic relatedness) and coresidence duration (between the subject's birth and 18th birthday).

For childhood (0-12 years) and at present, participants indicated on Likert scales whether discussing sexuality in the family, watching nudity on TV, and running into each other naked in the bathroom were accepted (1 = not at all accepted; 7 = very accepted). These results were then averaged and recoded as the variable 'openness towards sexuality in the family 0-12' and 'openness towards sexuality in the family now'. These variables were added to the analyses.

Disgust sensitivity was measured using a Dutch translation of the Disgust Scale-Revised (DS-R) (Haidt et al., 1994; modified by Olatunji et al., 2007), and a Dutch translation of the Three Domains Disgust Scale (TDDS) (Tybur et al., 2009). These scales were added to the analyses, to test whether fEMG in response to imagined sex with a brother would correlate with general disgust sensitivity. We were especially interested in potential associations with the 'sexual disgust' subscale of Tybur et al. (2009).

Finally, we asked participants to indicate, for each brother, the frequency of having bathed together, having slept in the same bedroom and having played together, both during early (subject 0-6 years old) and late (subject 7-12 years old) childhood (0 = never/my brother was not born yet, 1 = less than once a month, 2 = monthly, 3 = weekly, 4 = several times a week and 5 = daily). Bathing together and sleeping in the same bedroom are activities typically shared by siblings. Importantly, they are efficient cues for shared parental investment. For instance, when being bathed with a sibling, one observes one's mother or father taking care of another child. Sharing the same bedroom indicates cohabitation but, more specifically, it involves the observation of one's mother or father putting a sibling to bed. In other words, bathing together and sleeping in the same bedroom are associated with witnessing nurturing behaviour in one's mother or father towards another child. Therefore, the questions about bathing together and shared sleeping arrangements were averaged into the variables 'strong indicators for shared parental investment 0-6' and 'strong indicators for shared parental investment 7-12'. In contrast, playing with another child may be a less reliable indicator for shared parental investment, as it does not involve the observation of one's parent displaying nurturing behaviour towards another child. The analyses contrasting the potential effects of these sibling-typical activities and not-typical activities were planned to be mainly exploratory.

2.2.2.2 Post-experimental questionnaire

Participants rated on Likert-scales their success in following the instructions during the scenarios with their brother and their partner (1=not at all successful, 7=very successful).

2.2.2.3 Visual stimuli

The images used in the experiment showed three types of activities, all performed by a man and a woman. 'Neutral' images lacked any form of sexual or erotic tension and showed activities such as shopping, cooking or doing sport together. 'Mild sex' pictures were mildly erotically charged, and depicted activities such as cuddling, caressing or kissing on the mouth. The individuals in these pictures were naked, but no genitals were shown. 'Explicit sex' pictures were sexually explicit and showed a naked couple in various sexual positions with their genitals clearly exposed. These pictures had been chosen on the basis of a pilot study in which a different pool of 54 female students rated a large collection of pictures for being sexually arousing and disgusting (Likert scales: 1 = not at all, 7 = very). This collection was drawn from the International Affective Picture System (IAPS) and an internet search of type-matching pictures. During this pilot study, the pictures were shown one by one on a computer screen (at a resolution of 1024 × 768 pixels), with Likert scales shown immediately below the pictures. In order to avoid including images that themselves evoked disgust reactions, only pictures with mean disgust scores lower than 2 were retained for the experiment. As to sexual arousal, pictures that scored lower than 2 were considered neutral, those that scored between 3 and 5 were categorized as mild sex pictures, and those that scored higher than 5 were classified as explicit sex pictures. In sum, eighteen pictures sourced from outside the IAPS were selected for inclusion in the experiment (i.e., six pictures for each category). Pictures in the partner and brother scenarios (see below) were counterbalanced. To this end, the six images in each category were divided into two subsamples of three pictures each (subsamples A and B). Half of the subjects saw images of subsample A in the partner scenarios, while the other half saw this particular subset combined with brother scenarios. And vice versa for the images of subsample B.

The experiment (images + instructions) was programmed using *Inquisit 4.0* software produced by Millisecond Software. A written instruction preceded each picture, asking participants to imagine that they were performing the depicted activity themselves, either with their partner or with their oldest brother. The partner condition was added to distinguish psychophysiological responses related to normal sexual activities from responses related to incestuous activities. As regards the brother condition, participants were asked to imagine performing the activity with their oldest brother in order to decrease the likelihood of participants imagining sexual activities with a sexually immature brother. Participants whose oldest brother was younger than 12 years old

were planned to be excluded from all further analyses. Participants who did not have a brother or a partner at the time of the experiment were instructed to perform the imagery task as if they had one.

The various combinations of pictures and instructions resulted in a total of six scenarios, each involving three different pictures. In what follows, these scenarios will be referred to as ‘neutral activity with brother’, ‘neutral activity with partner’, ‘mild sex with brother’, ‘mild sex with partner’, ‘explicit sex with brother’ and ‘explicit sex with partner’. Both the ‘mild sex with brother’ and ‘explicit sex with brother’ scenarios suggest incestuous activities. The scenarios were presented in a random sequence, alternating categories.

2.2.2.4 Facial electromyography of *levator labii superioris alaeque nasi* (fEMG)

Standard procedures of surface electromyography were followed (Tassinari et al., 2000). Designated skin sites were cleaned with an alcohol solution. Conductance gel was put on three electrodes (Ø 3 mm): one was placed on the forehead (ground) while the other two were positioned in the *mm. levator labii region* on the left-hand side of the face.

2.2.2.5 Skin Conductance Response (SCR)

Participants washed their hands with tap water and dried them with a clean towel. Johnson & Johnson K-Y jelly conductive medium was applied to two standard Ag/AgCl electrodes (Ø 8 mm), which were subsequently attached to the thenar and hypothenar eminences of the left hand. The signal was measured using a constant voltage (0.5 V) coupler.

2.2.2.6 Heart Rate Change (HR)

Before the electrocardiogram was taken, designated skin sites were cleaned with an alcohol solution. Conductive gel was applied to three electrodes (Ø 8 mm): one was attached to the skin region immediately below the right clavicle while the other two were placed immediately below the lowest left and right ribs.

All physiological responses were recorded using a *Coulbourn Lablinc V*, gated to a computer by means of a Scientific Solutions DMA card.

2.2.3 Procedure

Each participant was tested separately. On arrival, the participant read an information sheet that briefly summarized the various parts of the experiment. After providing written informed consent, she completed the pre-experimental questionnaire on a

computer using the digital survey system *QuestionPro*. Test leaders provided sufficient space for privacy but remained nearby in case the participant had any questions.

Subsequently, the subject was guided to the lab room, where she was seated in front of a 17" computer screen placed approximately 50 cm in front of her. After applying the electrodes, a test leader instructed the participant to focus on the screen during the task, to avoid making unnecessary movements and to follow the instructions as closely as possible. When all signals were deemed free of artifacts, the program was started and the participant was led through a sequence of scenarios. Each scenario was programmed as a trial in which a white fixation cross was first shown in the middle of a black screen for one second. Two seconds later, a written instruction was shown for four seconds, asking the participant to imagine performing the activity that would be shown immediately afterwards with either her partner or her oldest brother. One second later, a picture of the activity in question was shown for an eight-second period. During the inter-trial interval, a black screen was displayed for a randomized timeframe of either 10, 12 or 14 seconds before a new fixation cross appeared announcing the beginning of a new trial. Figure 6 displays the procedural sequence of one trial.

After completion of the experimental task, which took approximately 20 minutes, the subject proceeded with the post-experimental questionnaire in a separate room, again on a computer using the digital survey system *QuestionPro*. Finally, the subject was debriefed, paid and provided with the contact details of the test leaders and caretakers.

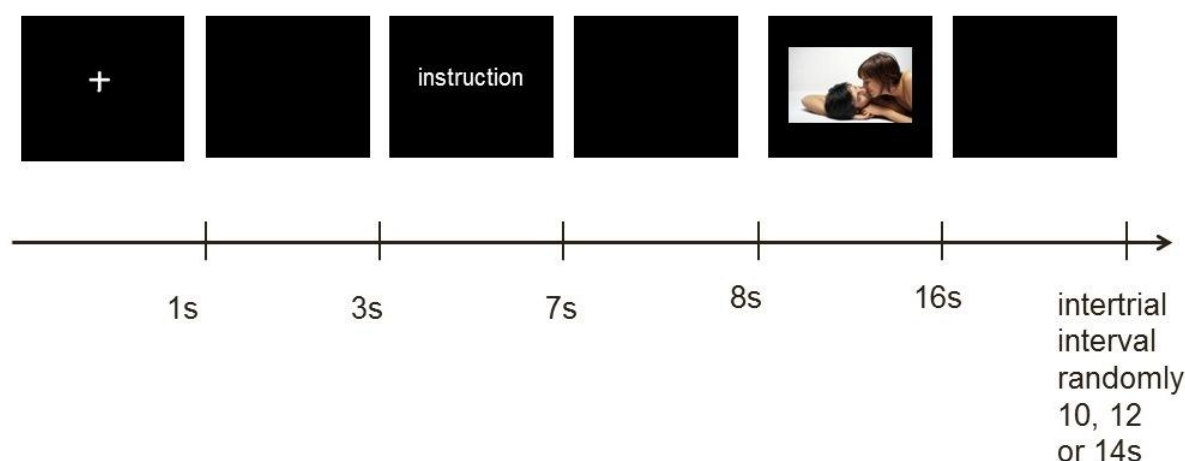


Figure 6 Procedural sequence of one trial. Instructions displayed were either 'Imagine that you perform the following act with your partner' or 'Imagine that you perform the following act with your brother'

2.2.4 Data recording and preparation.

SCR, HR and fEMG signals were digitized using customized software (Psychophysiological Recording; PSPHR) and processed offline by means of Psychophysiological Analysis (PSPHA) (de Clercq et al., 2006).

A single SCR score was obtained for each trial by subtracting the minimum value from the maximum value in the 1000-5000 ms time window after picture onset (cf. Prokasy & Raskin, 1973). As fEMG and HR response patterns for imagined disgust-evoking situations have been shown to differ between the first and second halves of an 8-second trial (Vrana, 1993), we calculated early and late responses for each trial. First-interval fEMG responses were obtained by subtracting the baseline value (mean 0-20 ms after picture onset) from the maximum value in the 21-4000 ms time window. Second-interval fEMG responses were obtained by subtracting the baseline value from the maximum value in the 4001-8000 ms time window after picture onset. First-interval HR responses were calculated by subtracting the baseline value (mean heart rate in the 0-4000 ms time window before picture onset) from the mean heart rate in the 0-4000 ms time window after picture onset. Second-interval HR responses were calculated by subtracting the baseline value from the mean heart rate in the 4001-8000 ms time window after picture onset.

Psychophysiological responses were averaged over the three trials in each category, thereby excluding missing and non-response values. This yielded a total number of 30 physiological responses: 6 SCR, 12 HR and 12 fEMG variables (see Table 1). Previous research has shown that a non-response rate of 25 % for SCR is to be expected in a sample of normal subjects aged under 25 (Venables & Mitchell 1996) and this was corroborated in our study.

Intervals*	PARTNER SCENARIOS					BROTHER SCENARIOS				
	SCR	fEMG		HR		SCR	fEMG		HR	
		1	2	1	2		1	2	1	2
Neutral	SCR _a	fEMG _a	fEMG _d	HR _a	HR _d	SCR _d	fEMG _g	fEMG _j	HR _g	HR _j
Mild sex	SCR _b	fEMG _b	fEMG _e	HR _b	HR _e	SCR _e	fEMG _h	fEMG _k	HR _h	HR _k
Explicit sex	SCR _c	EMG _c	fEMG _f	HR _c	HR _f	SCR _f	fEMG _i	fEMG _l	HR _i	HR _l

* Time intervals in the 8s time window after picture onset are referred to as '1' (first interval or first 4s) and '2' (second interval or last 4s)

Table 1 Overview of physiological output prior to data reduction: 6 SCR data (SCR a to f), 12 fEMG data (fEMG a to l) and 12 HR data (HR a to l)

2.2.5 Data reduction

Data were analyzed statistically using PASW 18.

Our psychophysiology method generated as many as 30 output responses (see Table 1), which leaves our critical tests open to criticism on the grounds of multiple testing. We therefore used two statistical procedures to check whether data reduction was possible.

In order to determine whether responses differed between the first and second intervals (HR, fEMG) and between mild and explicit sex pictures (SCR, HR, fEMG), a series of paired samples t-tests were conducted. When these t-tests did not generate statistically significant differences, pairs were combined by averaging the outcomes.

For the fEMG output, these analyses only revealed a significant difference between first- and second-interval fEMG responses for ‘mild sex brother’ (see Table 2). Since the interval difference for ‘explicit sex brother’ was found to be nearly significant, we opted to combine EMG responses to sex with brother scenarios into ‘fEMG sex brother 1’ and ‘fEMG sex brother 2’. Figure 7 shows that first interval responses are larger than responses in the second interval.

For the HR output, responses to ‘neutral brother’ and ‘mild sex brother’ showed to differ between the first and second intervals. The largest difference however was found between ‘mild’ and ‘explicit sex brother’ in the second interval (see Table 2). Therefore, we combined HR responses to incest into ‘HR1’, ‘HR2mild’ and ‘HR2explicit’.

For the SCR output, t-tests only revealed a significant difference between ‘mild’ and ‘explicit sex partner’ (see also Table 2).

The combined and remaining variables are presented in Figure 7.

In order to determine whether the sex with brother conditions elicited distinct physiological response patterns, three repeated measures ANOVAs were conducted (i.e. one for each physiological parameter) including the variables retained after the first round of data reduction (see figure 7). The results of these ANOVAs are reported in Table 3. It is shown that sex with brother conditions only elicited a distinct (namely a stronger) response pattern for fEMG. Sex with brother conditions did not produce a distinct SCR or HR response pattern. Consequently, we opted to focus on ‘fEMG sex brother 1’ and ‘fEMG sex brother 2’ responses in our critical tests.

In young adult females, childhood coresidence duration with a brother predicts fEMG measured facial disgust to imagined sex with that brother

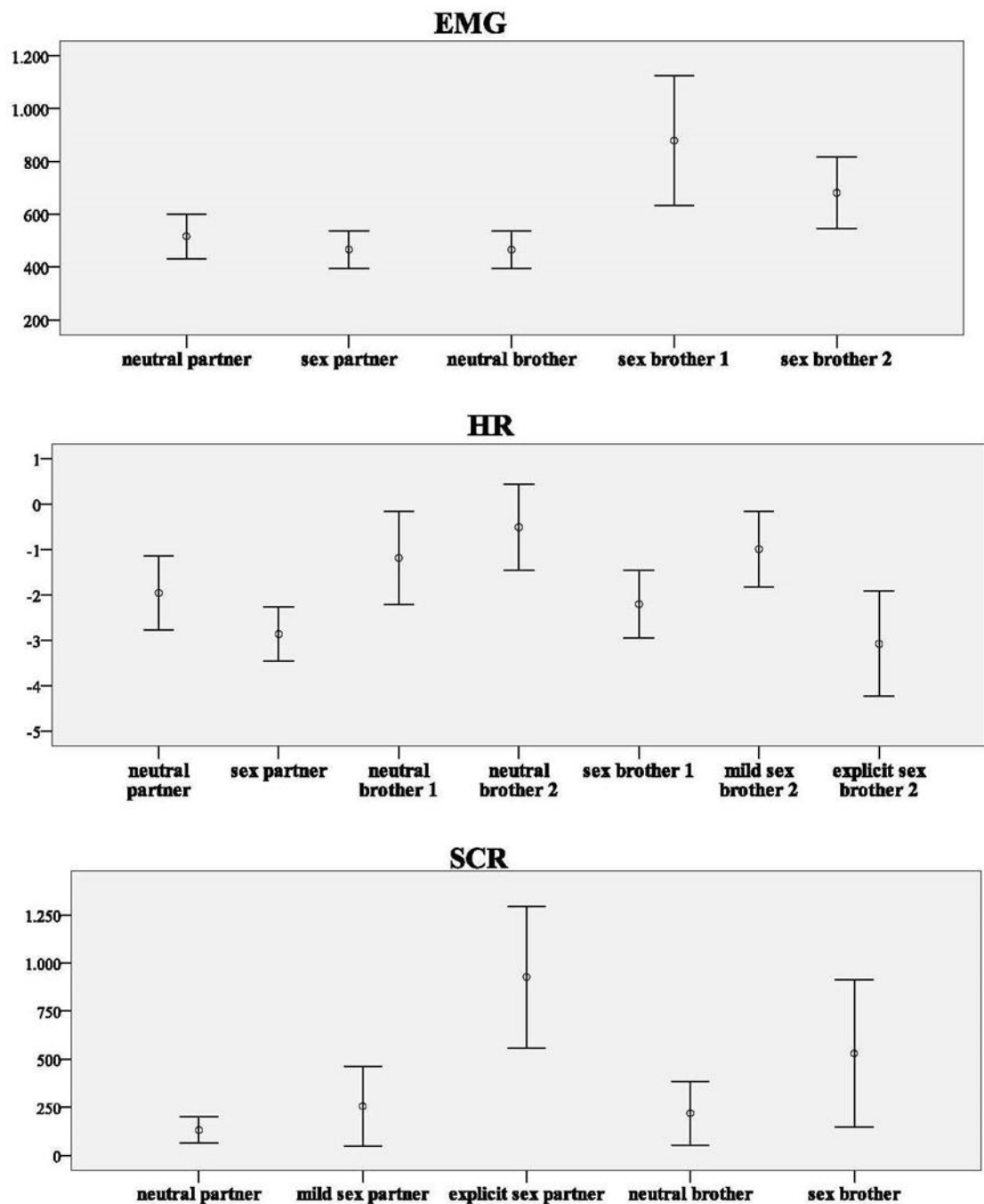


Figure 7 error bars (mean + 95% C.I.) of EMG, SCR and HR variables.

Error bars shown are for fEMG, HR and SCR responses, respectively. Scenarios used in the imagination task are referred to here as ‘neutral’ (= neutral activity with oldest brother or partner), ‘mild’ (= mildly erotic activity with brother or partner) and ‘explicit’ (= explicit sexual activity with brother or partner). ‘Sex’ refers to combined ‘mild’ and ‘explicit’ sex scenarios. Time intervals in the 8 seconds after picture onset are referred to as ‘1’ (first interval or first 4 seconds) and ‘2’ (second interval or final 4 seconds). Specific intervals and mild versus explicit sex scenarios are only mentioned where a significant difference exists between intervals or between mild and explicit scenarios; in all other cases, responses are combined as mean values.

Table 2 Paired samples t-tests: 1st vs. 2nd interval variables and mild vs. explicit sex variables

Paired conditions (M, SD)	<i>t</i>	<i>df</i>	<i>p</i>
fEMG			
<u>partner:</u>			
neutral 1 (525.26, 347.31) vs. 2 (505.26, 363.97)	.47	61	.642
mild sex 1 (466.46, 264.23) vs. 2 (459.21, 298.84)	.26	61	.798
explicit sex 1 (532.79, 539.65) vs. 2 (478.76, 348.31)	1.13	61	.261
mild sex 1 (466.46, 264.23) vs. explicit sex 1 (532.79, 539.65)	-1.05	61	.300
mild sex 2 (456.80, 297.04) vs. explicit sex 2 (476.47, 345.96)	-.58	62	.567
<u>brother:</u>			
neutral 1 (481.81, 310.05) vs. 2 (462.19, 287.66)	.56	61	.578
mild sex 1 (858.56, 918.79) vs. 2 (639.28, 511.26)	3.12	58	.003
explicit sex 1 (906.96, 993.17) vs. 2 (727.68, 594.26)	1.89	59	.063
mild sex 1 (857.34, 926.77) vs. explicit sex 1 (901.84, 1006.81)	-.71	57	.481
mild sex 2 (648.11, 502.68) vs. explicit sex 2 (745.88, 600.60)	-1.79	62	.078
HR			
<u>partner:</u>			
neutral 1 (-2.23, 3.78) vs. 2 (-1.69, 4.29)	-.87	61	.390
mild sex 1 (-2.52, 3.35) vs. 2 (-3.09, 3.47)	1.66	61	.101
explicit sex 1 (-2.75, 2.92) vs. 2 (-3.09, 3.15)	.78	61	.441
mild sex 1 (-2.64, 3.44) vs. explicit sex 1 (-2.67, 2.97)	.07	62	.946
mild sex 2 (-3.09, 3.15) vs. explicit sex 2 (-3.09, 3.15)	.00	61	.998
<u>brother:</u>			
neutral 1 (-1.18, 4.04) vs. 2 (-.51, 3.73)	-2.26	61	.027
mild sex 1 (-1.98, 3.64) vs. 2 (-.99, 3.30)	-2.53	61	.014
explicit sex 1 (-2.43, 4.05) vs. 2 (-3.08, 4.56)	1.42	61	.159
mild sex 1 (-2.02, 3.63) vs. explicit sex 1 (-2.46, 4.02)	.70	62	.489
mild sex 2 (-.99, 3.30) vs. explicit sex 2 (-3.08, 4.56)	2.94	61	.005
SCR			
<u>partner:</u>			
mild sex (256.21, 566.90) vs. explicit sex (1010.78, 1081.91)	-4.95	48	.000
<u>brother:</u>			
mild sex (745.34, 1200.06) vs. explicit sex (937.87, 1649.22)	-1.16	50	.248

Table 3 Repeated measures ANOVAs on fEMG, HR and SCR variables (after first data reduction)

F-values per test ¹	factor levels per test	Post-Hoc Pairwise Comparisons ²		N	mean difference	SE	p
fEMG $F_{1,33,76.02} = 10.14$, $p < .01$	neutral partner sex partner neutral brother sex brother 1 sex brother 2	sex brother 1	> neutral partner	58	363.25	121.11	.040
			> sex partner	58	413.41	113.96	.006
			> neutral brother	58	414.29	123.23	.014
		sex brother 2	> sex partner	58	215.47	54.85	.002
			> neutral brother	58	216.35	64.25	.014
HR $F_{3,98,243.00} = 5.94$, $p < .001$	neutral partner sex partner neutral brother 1 neutral brother 2 sex brother 1 mild sex brother 2 explicit sex brother 2	sex partner < neutral brother 1		62	-1.68	0.52	.045
		< neutral brother 2		62	-2.35	0.50	.000
		< mild sex brother 2		62	-1.87	0.52	.014
		explicit sex brother 2 < neutral brother 2		62	-2.57	0.72	.015
SCR $F_{2,40,88.84} = 10.20$, $p < .001$	neutral brother neutral partner mild sex partner explicit sex partner sex brother	explicit sex partner > neutral brother		38 ³	709.14	163.50	.001
		> neutral partner		38 ³	795.71	178.30	.001
		> mild sex partner		38 ³	671.72	177.10	.005

¹ Degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity.

² Pairwise comparisons were conducted with Bonferroni correction. Only significant differences ($p < .05$) are reported.

³ N is smaller in pairwise comparisons of SCR responses than in EMG and HR responses due to the list wise exclusion of missing observations in Repeated Measures ANOVA. Whereas all SCR data were missing for seven participants, the amount of missing SCR values in separate scenarios was generally low for the remaining 56 subjects (<10%).

2.3 Results

2.3.1 Descriptive statistics: sexual orientation and type of brother(s)

Data on 77 female students (age Mean \pm SE = 21.39 \pm 1.77, N = 75, two missing values) were gathered. None of the participants aborted the experiment prematurely. Two participants were excluded from further analyses due to technical problems encountered while measuring their psychophysiological responses. Of the 75 remaining subjects, 63 reported being heterosexual, 7 reported being homosexual or bisexual and 5 did not provide any information about their sexual orientation. As the partner scenarios used in the experiment depicted only male-female sexual interaction, homosexual and bisexual respondents involved in same-sex relationships were asked to imagine female-female sexual activity while observing a male-female sexual activity. This discrepancy might have elicited a psychophysiological bias. Similarly, in the scenarios involving sex with a brother, non-heterosexual participants had to imagine not only having sex with their own brother but also engaging in an activity that may in itself have conflicted with their sexual orientation. In order to get around this potential bias, statistical analyses were performed only on the pool of heterosexual respondents (N = 63). Of these, 37 (58.7%) reported having a partner while 26 (41.3%) indicated that they were single.

The number of brothers participants had (ranging from zero to seven) and their types of biological relatedness (i.e. full or half-siblings or no genetic relatedness) are summarized in Table 4. With the exception of one oldest brother aged 12 and two aged 14, all oldest brothers were 16 years old or over at the time of the experiment. All brothers, including those aged under 16, were included in the analyses.

Table 4 Number and type of brothers

<i>Number of brothers</i>	0	1	2	3	4	5	Tot
N participants	20	29°	10	2	1	1	63
N participants with at least 1 younger brother [proxy for MPA presence]		18	8	2	1	1	30
<i>N full brothers</i>		17	13	1	2	3	36
<i>N half brothers</i>		0	3	5	0	2	10
<i>N step brothers</i>		1	0	0	2	0	3
N participants with only older brothers [proxy for MPA absence]		9	2	0	0	0	11
<i>N full brothers</i>		9	4				13
<i>N half brothers</i>		0	0				0
<i>N step brothers</i>		0	0				0

°Two participants with one brother did not provide information on their brother's age, hence the N of participants in the rows below equals 27.

2.3.2 Feasibility of imagining brother versus partner acts

In line with the plausible argument that it is easier to imagine having sex with a partner than with a brother because it is more common in real life, subjects indicated experiencing more success in imagining scenarios with their partner (Mean \pm SE = 6.30 \pm 0.72, N = 60, three missing values) than with their brother (Mean \pm SE = 4.27 \pm 1.75, N = 60, three missing values). However, this response pattern could also be expected from a social desirability perspective: it is possible that participants played down the ease of imagining sexual scenarios with their brothers because of how this may be perceived. Interestingly, subjects with brothers (Mean \pm SE = 4.38 \pm 1.69, N = 40, three missing values) performed only slightly better at imagining the scenarios with brother than those without brothers (Mean \pm SE = 4.05 \pm 1.91, N = 20).

2.3.3 Effects of coresidence duration, attitudes towards sexuality in the family, and disgust sensitivity (all subjects)

First, there were no significant differences in responses between subjects with at least one brother and without brothers (see table 5).

Variation in coresidence duration with brother(s) was found to be appropriate for analysis (Mean \pm SE = 12.14 \pm 12.07, N = 63). As can be expected, subjects with more brothers reported a longer total coresidence duration.

In females with at least one younger brother (proxy for MPA presence), coresidence duration with all brothers was not found to correlate with 'EMG sex brother 1' or with 'fEMG sex brother 2' (see Table 6). In females with only (one or more) older brothers (proxy for MPA absence), coresidence duration with all brothers positively correlated with 'EMG sex brother 1' but not with 'fEMG sex brother 2'. Thus, the longer an MPA-absent female had co-resided with her brother(s) in the period between her birth and 18th birthday, the stronger her first-interval fEMG responses were when imagining having sex with her oldest brother.

Even in today's modern society, coresidence duration can be expected to be associated with degree of genetic relatedness. So ideally, this is a factor that should be controlled for, in order to exclude that the effect of coresidence duration was not driven by genetic relatedness instead. However, we were unable to do so, since most of our subjects' brothers were full brothers (see Table 4). Nonetheless, our data indicate a significant effect of coresidence duration in subjects with only older brothers (proxy for MPA absent) but not in subjects with at least one younger brother (proxy for MPA present). This effect can not be explained in terms of differences in genetic relatedness.

49% of females reported remembering being told by their parents that sexual contact between family members is inappropriate. This did not correlate with fEMG responses.

Also, fEMG responses did not correlate with openness towards sexuality in the family, sexual disgust sensitivity and general disgust sensitivity (see Table 6).

Table 5 Independent samples T-tests for differences in fEMG responses between females without brothers and females with at least one brother

Independent conditions	Mean (SD)	t	df	p
fEMG1				
no brother	673.69 (636.41)	-1.44	58 ¹	.157
at least one brother	925.91 (618.47)			
fEMG2				
no brother	709.90	.14	61	.892
at least one brother	690.99			

¹After omitting two outlying variables in fEMG responses

Table 6 fEMG responses and coresidence duration, attitudes towards sexuality in the family, and disgust sensitivity

Correlation tests		Pearsons r	p	N
fEMG sex brother interval 1				
coresidence duration	MPA present subjects	.30	.119	28
	MPA absent subjects	.66	.037	10
openness sexuality family 0-12		.17	.197	62
openness sexuality family now		.20	.116	62
parental instruction incest		.14	.304	56
DS-R		-.05	.715	58
TDDS		.02	.910	62
sexual disgust (TDDS)		.03	.806	60
fEMG sex brother interval 2				
coresidence duration	MPA present subjects	.06	.737	30
	MPA absent subjects	-.12	.720	11
openness sexuality family 0-12		.02	.902	63
openness sexuality family now		-.01	.954	63
parental instruction incest		.06	.642	57
DS-R		-.01	.953	63
TDDS		.01	.968	63
sexual disgust (TDDS)		.04	.737	61

2.3.4 Effects of specific experiences with brothers in childhood (subjects with one brother)

All analyses described in this section are exploratory. In order to facilitate data processing, only females with one brother (N = 29) were analyzed.

Of the childhood activities surveyed, playing together in early and late childhood correlated most strongly ($r = .86$, $p < .001$). These results were therefore averaged under the variable ‘weak indicator for shared parental investment 0-12’ (Mean± SE = 4.00±.85, N = 28). No significant correlation ($r = .35$, $p = .106$, N = 22) was found between strong indicators for shared parental investment in early childhood (Mean± SE = 2.42±.87, N = 24) and strong indicators for shared parental investment in late childhood (Mean± SE = 1.41±.67, N = 27). Both first- and second-interval fEMG responses to incest correlated with frequency of strong indicators for shared parental investment in early childhood (see Table 7). fEMG responses did not correlate with strong indicators for shared parental investment in late childhood or with weak indicator for shared parental investment 0-12.

Table 7 EMG responses and brother relation characteristics (subjects with 1 brother)

Correlation tests	Pearsons r	p	N
fEMG sex brother 1			
weak indicator for shared parental investment 0-12	-.07	.756	24
strong indicators for shared parental investment 0-6	.53	.016	20
strong indicators for shared parental investment 7-12	-.11	.626	23
fEMG sex brother 2			
weak indicator for shared parental investment 0-12	-.12	.537	28
strong indicators for shared parental investment 0-6	.47	.020	24
strong indicators for shared parental investment 7-12	.03	.881	27

2.4 Discussion

In this study, we applied an alternative approach to the study of human incest aversion. Combining the standard method of written surveys with psychophysiological responses (SCR, fEMG and HR) measured during an imagery task meant that ceiling effects and the effects of social desirability could be avoided much more effectively. Exploring the utility of this novel approach allowed us to test the validity of the Lieberman et al.

(2007) model for the computational architecture of sibling detection that considers coresidence duration and maternal perinatal association as two central mechanisms.

Of the psychophysiological parameters used, the activity of the *levator labii superioris alaeque nasi* (i.e. the facial EMG measure) appears to be a particularly reliable measure of incest aversion in female subjects. In comparison to neutral scenarios and sex-with-partner scenarios, fEMG responses were noticeably higher where mild and explicit sex-with-brother scenarios were concerned. Interestingly, the strongest fEMG response when imagining sex with a brother was observed during the first interval (4 s) after stimulus onset. These results do not align with Vrana (1993) who observed an increase in *levator labii* muscle tension during the last half of an 8-second time window in which subjects imagined situations involving the experience of disgust (e.g. the ingestion of a slug). Also Stark et al. (2005) could only detect a difference in *levator labii* fEMG response between neutral and disgusting stimuli (e.g. displaying poor hygiene and mouldy food) during the last half of an 8-second time window, not during the first half. So, compared to other (not-sexually related) disgust evoking stimuli, imagined sexual contact with a brother seems to stand out by immediately eliciting a strong facial disgust expression which decreases over time. For additional discussion related to this finding we refer the reader to the conclusion of part 1.

The other two psychophysiological parameters provided less distinctive results, which made them more difficult to interpret. HR, for instance, decreased most in second-interval explicit sex-with-brother scenarios and in sex-with-partner scenarios. This aligns well with studies that have characterized HR as an unreliable indicator for distinguishing pleasant and unpleasant stimuli in general (Bernat et al., 2006), and for distinguishing responses to disgust-evoking stimuli in particular (see section 1.3.2 above). SCR also failed to provide straightforward results. The largest increase in SCR was observed in explicit sex-with-partner scenarios, which might have been indicative for the experience of sexual arousal. Sex-with-brother scenarios evoked a moderate increase in SCR, which aligns with earlier studies including other disgust-related items (see section 1.3.2 above). All in all, our results align with the proposition that HR and SCR responses are not indicative for experienced disgust (again, see section 1.3.2).

With regard to coresidence duration and MPA as sibling detection mechanisms, the results of our study align with the Lieberman et al. (2007) model: coresidence duration affects incest aversion only in subjects who did not witness their mother taking care of an opposite-sex infant sibling. We observed that childhood coresidence duration predicted higher first-interval fEMG responses in females who only had older brothers. Coresidence duration did not predict second-interval fEMG responses, however. Re-testing with larger subject pools is therefore needed to be able to establish with any certainty that the Lieberman et al. (2007) computational model on human sibling detection can predict females' EMG responses to imagined sex with a brother.

The results described here offer an interesting perspective on the potential effects of shared specific experiences with brothers during childhood. Our study is the first to indicate that the frequency of experiences that strongly indicate shared parental investment with an opposite-sex child positively correlates with later sexual aversion. Specifically, fEMG responses when imagining sex with a brother were positively associated with bathing together and sleeping in the same bedroom during childhood. This was demonstrated for both first- and second-interval EMG responses. In contrast, the frequency of a playing together, averaged for early and late childhood, was not associated with fEMG outcomes. The results also suggest that shared sibling-typical activities only *during early childhood* (0-6 years) are relevant for later incest aversion. This fits well with previously reported observations that early childhood coresidence might also be of special relevance (e.g. Shepherd, 1971; Wolf, 1995). However, all of this needs additional confirmation with a larger subject sample.

In conclusion, the study of human incest avoidance can benefit from a psychophysiological approach that focuses on facial EMG activity of the *mm. levator labii* region. Apart from providing further support for the effects of coresidence and MPA, it also indicates that activities that can be expected to be typically shared with genetically related children (in this case, sleeping in the same bedroom and bathing together) may allow additional theoretical refinement of the sibling detection system. Although the study provides a fresh perspective on the study of human incest aversion, the obtained results are mainly exploratory. Therefore, we proceeded with a follow-up study, which will be described in the following chapter. The same experimental design was applied to a larger subject sample of women, while at the same time also allowing men to participate.

Chapter 3 fEMG-measured facial disgust when imagining sex with a sibling, part 2: gender differences and cues for shared parental investment

3.1 Introduction

Starting from the hypothesis that the sexual reproduction of close genetic relatives leads to genetically burdened offspring, researchers have collected evidence for the existence of evolved psychological foundations for avoiding incest (e.g. Lieberman et al., 2003, Lieberman et al., 2007). According to The evolutionary psychology of incest aversion, a spontaneous sexual aversion is expected to develop naturally between close genetic relatives, and thus should not be learned through cultural transmission (Westermarck, 1891). The computational mechanisms that lead to the experience of sexual aversion are expected to operate at the subconscious level, and involve the processing of reliable cues for genetic relatedness.

As discussed in chapter 1, two cues have been identified for the detection of siblings based on contextual information (i.e. through childhood association). The first one, originally put forth by the Finnish anthropologist Edward Westermarck (1891), is coresidence duration. The second one, identified by Lieberman et al. (2007), is observing one's mother taking care of an infant (MPA). In the previous chapter, we applied the measurement of physiological correlates to the study of sibling incest aversion in adult females. This provided us with additional evidence for the hypothesis that MPA is the most reliable indicator for sibling relatedness, while coresidence duration functions as a secondary system, that is activated when the most reliable cue, MPA, is unavailable (Lieberman et al., 2007). However, these were highly provisional findings that asked for a replication using a larger subject sample, this time also including males. The study

described in this chapter aims to accommodate this need. Basically, its specific aim was threefold.

First of all, we aimed to bring clarification in the attested association between facial disgust during the imagination of sex with a brother and cues that are hypothesized to be highly indicative for shared parental investment (chapter 2). Specifically, it was found that females' fEMG responses in the *levator labii* region during the imagination of sex with a brother were positively associated with reported frequency (between subject's ages 0- 6) of having bathed with that brother and having shared the same bedroom. In contrast, these fEMG responses were not associated with reported frequency of playing together with a sibling. Potentially, these preliminary findings are subtly disclosing which kinds of experiences are of special relevance during coresidence duration. As explained by Lieberman (2009), the time of shared parental investment is central to the Westermarck effect:

“As Westermarck proposed, childhood association, or more specifically *the period of shared parental investment*, is one cue that would have reliably identified siblings in ancestral environments. Because children received high levels of parental investment throughout childhood, typically tapering off around puberty, years of association until maturity would have been informative in assessing the probability of relatedness.” [emphasis added] (Lieberman 2009, p. 157)

Hypothetically, during childhood coresidence, the sibling detection system picks up and processes specific experiences with siblings that are highly reliable indicators of shared parental investment. Besides coresidence itself (i.e. living under the same roof), such experiences with older siblings (e.g. being bathed together) may be used as specific input by the kin detection system. The prioritized processing of high quality cues (such as being bathed together) in contrast to lower quality cues (such as playing together) aligns with adaptationist principles of good Bayesian design (see Lieberman et al., 2007). As older siblings have been shown to give priority to MPA (i.e. the higher quality cue) over coresidence duration (see Lieberman et al., 2007, supplementary information, p. 1), there are firm reasons to believe that efficiency principles are at work during the detection of siblings.

While this idea is not novel at all (see quote above, Lieberman, 2009), there is a lack of published research reporting on the potentially differential effects of experiences that relate to shared parental investment in a weak vs. a strong way. As to our knowledge, there is only one such publication, by Walter (1997), reporting on data collected in Morocco. It was shown that, for both males and females, having shared a bedroom with an opposite-sex child during childhood was associated with a rejection of that specific individual as a potential mate in adulthood. In contrast, early childhood social

interaction did not significantly predict the self-reported value of that person as a potential marriage partner. These conclusion, however, were drawn from a rather small sample size ($N = 17$).

Therefore, the first aim of this study was to continue on this track, and to test for potential differential effects of these experiences in MPA absent and MPA present females. As explained above, the most reliable cue for sibling relatedness has been hypothesized to be MPA. For those subjects, coresidence duration should be of much less importance, or even no importance. Likewise, we expected that being bathed together or having shared the same bedroom would only predict facial disgust expressions to imagined incest in subjects who did not experience MPA.

The second specific aim of this study was to test for gender differences in strongness of fEMG response to imagined sex with an opposite-sex sibling. While testing the evolved psychological basis of inbreeding avoidance, researchers have documented that females' self-reports of aversion towards incest are higher than males' (e.g., Walter, 1997; Walter & Buyske, 2003; Fessler and Navarrete, 2004; Lieberman & Lobel, 2012; Antfolk et al., 2012a and 2012b). These data align with predictions that derive from evolutionary parental investment theory (Trivers, 1972; see also section 1.2.1 above). We have no knowledge of published data that show that, besides higher *self-reported* aversion, females also display stronger facial disgust than males when asked to imagine sex with an opposite-sex sibling. So, the second aim of this study was to replicate these earlier attested gender differences in incest aversion, but this time at the level of displayed facial disgust.

Our third aim was to replicate for males what we earlier found for females, as described in the previous chapter. For females, we ascertained that duration of coresidence predicted strongness of fEMG measured facial disgust in response to imagined sex with a brother, but only when MPA was absent. As earlier research using self-reports indicated, one can expect to find similar effects in males (e.g. Lieberman et al., 2003; Lieberman et al., 2007).

Besides the three aims described above, we additionally tested for the potential critical relevance of coresidence duration during early childhood. As described in section 1.2.2, there is limited evidence that coresidence duration during early childhood, especially from birth until the age of 3, might be of special relevance. Therefore, we performed additional tests for the effects of coresidence duration between birth and the age of 3, between birth and the age of 6, and between the ages of 7 and 12.

Importantly, we also implemented a methodological improvement in the analysis of the data. In the previous chapter, coresidence duration with *all* opposite-sex siblings was used as the independent measure in the critical analyses. However, facial disgust when imagining sex with one's *oldest opposite-sex sibling* (which was the explicit task

instruction) should actually be predicted by coresidence duration with that specific sibling.

3.2 Methods

3.2.1 Participants

Data of 148 participants (age Mean \pm SE =19.95 \pm 1.90, 50.7% males) were gathered. All subjects completed full participation for which they received a financial compensation of 10€. Participants who reported not to be heterosexual (N= 14, 8 males) or whose oldest opposite-sex sibling was younger than 12 years old (N= 7, 2 males) were excluded from the analyses. As for males we mainly aimed to replicate the findings obtained earlier for females (see chapter 2), having at least one sister was not a selection criterion for males to participate in the study. However, having at least one brother was a selection criterion for females to participate. For females, we mainly aimed to refine the effects of shared experiences with brother during childhood (which requires having at least one brother), and to test for potential differences in responses because of difference in genetic relatedness (which again requires having at least one brother). Therefore, we actively recruited women who had at least one half- or stepbrother. To enlarge our female sample size, the critical tests were performed on the total female subject sample (i.e., the data gathered here together with the 43 heterosexual females with at least one brother from gathered for the study described in chapter 2). This resulted in a total sample size of 170 participants (66 males).

3.2.2 Materials

3.2.2.1 Questionnaires

Prior to the imagery task, participants completed a questionnaire that was almost identical to the ‘pre-experimental questionnaire’ of the study described in chapter 2 (see section 2.2.2.1).

Worth repeating is that, for each opposite sex sibling, the frequency of having bathed together, having slept in the same bedroom and having played together, both during early (subject 0-6 years old) and late (subject 7-12 years old) childhood (0= never or my brother/sister was not born yet, 1 = less than once a month, 2 = monthly, 3 = weekly, 4 = several times a week and 5 = daily). Additionally we included frequency of quarrelling,

again measured separately for early childhood (subject ages 0-6) and late childhood (subject ages 7-12). As bathing together and sleeping in the same bedroom are two activities that strongly indicate shared parental investment, they were again added up into the variables 'strong indicators for shared parental investment 0-6' or shortly 'SPI 0-6' and 'strong indicators for shared parental investment 7-12' or shortly 'SPI 7-12'. Playing together and quarrelling, on the other hand, are activities that weakly indicate shared parental investment, and were added up into the variables 'weak indicators for shared parental investment 0-6' or shortly 'WPI 0-6' and 'weak indicators for shared parental investment 7-12' or shortly 'WPI 7-12'.

The brief questionnaire that was completed after the imagery task was identical to the 'post-experimental questionnaire' of the study described in chapter 2 (see section 2.2.2.2).

3.2.2.2 Visual stimuli

The visual stimuli used in the experiment were identical to the stimuli of the study described in chapter 2 (see section 2.2.2.3).

3.2.2.3 Psychophysiological measures

The psychophysiological measures collected in this study were identical to the ones collected in the study described in chapter 2. For males, we gathered data on facial electromyography in the *levator labii superioris alaeque nasi* region (fEMG), skin conductance response (SCR) and heart rate (HR). For females, only fEMG data were collected since the study described in chapter 2 had already shown that only this physiological measure showed a distinct response pattern to imagined sex with a brother.

Similar to the study described in chapter 2, all physiological responses were recorded using a Coulbourn Lablinc V, gated to a computer by means of a Scientific Solutions DMA card.

3.2.3 Procedure

The procedure was identical to the procedure of the study described in chapter 2 (see section 2.2.3).

3.2.4 Data recording and preparation

Data were recorded and prepared using the same procedures of the study described in chapter 2 (see section 2.2.4).

3.2.5 Data reduction

Identical data reduction strategies were applied as in the study described in chapter 2 (see section 2.2.5). First, we tested whether responses significantly differed between the ‘mild’ and ‘explicit’ image trials, and between the 1st and 2nd interval response windows. Secondly, for males, we looked at which physiological variables elicited distinct responses to incest.

For males, in order to determine whether responses differed between the first and second intervals (HR, fEMG) and between mild and explicit sex pictures (SCR, HR, fEMG), a series of paired samples t-tests were conducted. When these t-tests did not generate statistically significant differences, pairs were combined by averaging the outcomes. For females, the same strategy was applied to the fEMG data.

In both males and females, fEMG responses did not differ consistently between mild and explicit sex with partner scenarios, and between 1st and 2nd interval responses for both neutral activities and sex with partner activities. Again across both genders, EMG responses did not differ significantly between first and second interval neutral activities with an opposite-sex sibling, and also not between imagined mild sex and explicit sex with an opposite-sex sibling (with the exception of 2nd interval responses in females). For both sexes, fEMG responses to imagined sex with an opposite-sex sibling significantly differed between the 1st and the 2nd interval (for males, only for imagined mild sex).

Based on these results, we decided for both sexes to average and combine fEMG responses to imagined sex with an opposite-sex sibling into the variables: ‘1st interval responses to imagined sex with an opposite-sex sibling’ (shortly ‘fEMG 1’) and ‘2nd interval responses to imagined sex with an opposite-sex sibling’ (shortly ‘fEMG 2’).¹ For both sexes, fEMG responses to neutral scenarios (partner and sibling) were averaged across both intervals, and fEMG responses to sex with partner scenarios were averaged across intervals and mild vs. explicit sex. The resulting variables for analysis are summarized in figure 8 for females, and figure 9 for males.

For males, HR responses did not differ between mild and explicit sex with partner scenarios, and between mild and explicit sex with sister scenarios. However, in almost all scenarios we observed a stronger decrease in HR in the first interval compared to the second interval. Based on these results, we averaged responses over mild and explicit sex scenarios, but maintained the distinction between first and second interval responses. The resulting variables for analysis are summarized in figure 10.

¹ The data reduction strategy had the exact same outcome for the ‘sex with sibling’ conditions in the study described in chapter 2.

For males, SCR was not different in response to mild and explicit sex imagined with a sister. However, SCR was significantly higher during imagined explicit sex with a partner than imagined mild sex with a partner. Based on these results, SCR was averaged for sex with sister, but the distinction between SCR responses to mild and explicit sex imagined with a partner was obtained. The resulting variables for analysis are summarized in figure 11.

For males, in order to determine which physiological parameters elicited distinct response patterns to imagined sex with a sister, three repeated measures ANOVAs were conducted (i.e. one for each physiological parameter) including the variables retained after the first round of data reduction (see figures 9, 10 and 11). For females, one repeated measures ANOVA tested whether fEMG responses elicited a distinct response pattern to imagined sex with a brother (see figure 8).

For both males and females, repeated measures ANOVA showed significant differences in EMG responses between scenarios (females: $F_{4,412} = 24.55, p = .000$; males: $F_{4,260} = 12.30, p = .000$). fEMG responses to imagined sex with an opposite-sex sibling were significantly higher than fEMG responses to all other scenarios.

For males, repeated measures ANOVA showed significant differences in SCR responses between scenarios ($F_{4,176} = 13.45, p = .000$). SCR responses to imagined sex with a sister were significantly higher than in all other scenarios except explicit sex with a partner. Another repeated measures ANOVA showed significant differences in HR responses between scenarios ($F_{7,448} = 4.52, p = .000$). However, there was no distinct response pattern for HR responses to imagined sex with a sister.

In sum, for both males and females, fEMG elicited a distinct response pattern to imagined sex with an opposite sex sibling. Consequently, we opted to focus for both genders on fEMG in our critical tests.

Table 8 Paired samples t-tests: 1st vs. 2nd interval variables and mild vs. explicit sex variables (males, N=66)

Paired conditions (<i>M, SD</i>)	<i>t</i>	<i>df</i>	<i>p</i>
fEMG			
<u>partner:</u>			
neutral 1 (427.07, 368.21) vs. 2 (456.73, 398.36)	-.73	65	.466
mild sex 1 (299.28, 222.95) vs. 2 (335.47, 308.09)	-.98	65	.331
explicit sex 1 (328.37, 284.53) vs. 2 (435.75, 675.06)	-1.38	65	.173
mild sex 1 vs. explicit sex 1	-.89	65	.378
mild sex 2 vs. explicit sex 2	-1.17	65	.248
<u>sister:</u>			
neutral 1 (307.98, 217.64) vs. 2 (328.31, 257.65)	-.66	65	.515
mild sex 1 (860.84, 1348.00) vs. 2 (551.77, 742.49)	2.79	65	.007
explicit sex 1 (929.12, 1328.61) vs. 2 (741.77, 1237.24)	1.41	65	.165
mild sex 1 vs. explicit sex 1	-.44	65	.660
mild sex 2 vs. explicit sex 2	-1.37	65	.175
HR			
<u>partner:</u>			
neutral 1 (-3.31, 3.97) vs. 2 (-1.72, 4.35)	-3.66	64	.001
mild sex 1 (-2.19, 4.96) vs. 2 (-2.40, 4.47)	.41	64	.685
explicit sex 1 (-1.98, 3.97) vs. 2 (-3.34, 3.99)	3.05	64	.003
mild sex 1 vs. explicit sex 1	-.27	64	.788
mild sex 2 vs. explicit sex 2	1.45	64	.153
<u>sister:</u>			
neutral 1 (-2.52, 3.73) vs. 2 (-.72, 3.81)	-4.39	64	.000
mild sex 1 (-2.42, 4.11) vs. 2 (-1.62, 4.01)	-2.01	64	.048
explicit sex 1 (-1.88, 4.15) vs. 2 (-1.45, 4.95)	-.90	64	.372
mild sex 1 vs. explicit sex 1	-.92	64	.359
mild sex 2 vs. explicit sex 2	-.27	64	.786
SCR			
<u>partner:</u>			
mild sex (969.63, 1134.46) vs. explicit sex (1750.61, 1649.61)	-4.05	57	.000
<u>sister:</u>			
mild sex (2081.27, 2296.19) vs. explicit sex (1941.29, 2182.92)	.60	62	.548

Table 9 Paired samples t-tests: 1st vs. 2nd interval variables and mild vs. explicit sex variables (females, N=104)

Paired conditions (M, SD)	<i>t</i>	df	<i>p</i>
fEMG			
partner:			
neutral 1 (460.24, 356.47) vs. 2 (424.21, 274.99)	1.65	103	.102
mild sex 1 (412.35, 293.49) vs. 2 (380.41, 285.00)	1.27	103	.208
explicit sex 1 (546.35, 631.34) vs. 2 (421.87, 308.87)	2.64	103	.010
mild sex 1 vs. explicit sex 1	-2.36	103	.020
mild sex 2 vs. explicit sex 2	-1.65	103	.101
brother:			
neutral 1 (431.28, 323.41) vs. 2 (400.75, 283.26)	1.11	103	.270
mild sex 1 (950.53, 1205.97) vs. 2 (589.94, 527.83)	3.31	103	.001
explicit sex 1 (975.13, 1090.93) vs. 2 (721.49, 666.72)	3.06	103	.003
mild sex 1 vs. explicit sex 1	-.28	103	.779
mild sex 2 vs. explicit sex 2	-2.00	103	.049

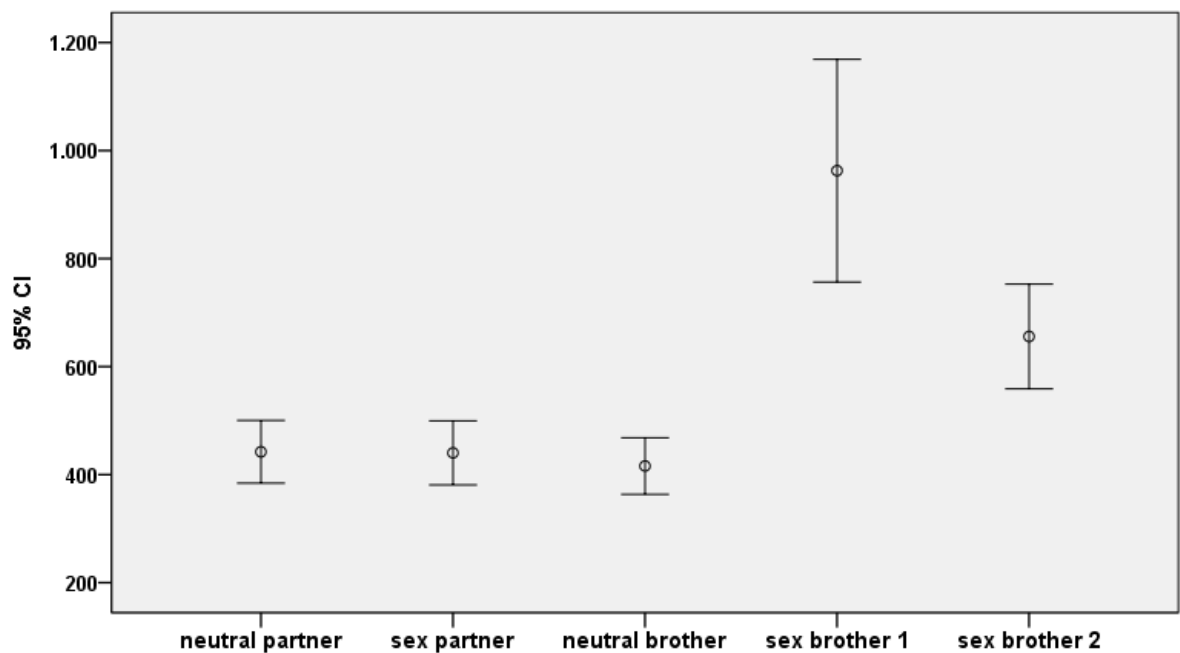


Figure 8 Error bars (mean and 95% mean C.I.) of EMG responses in females (N=104)

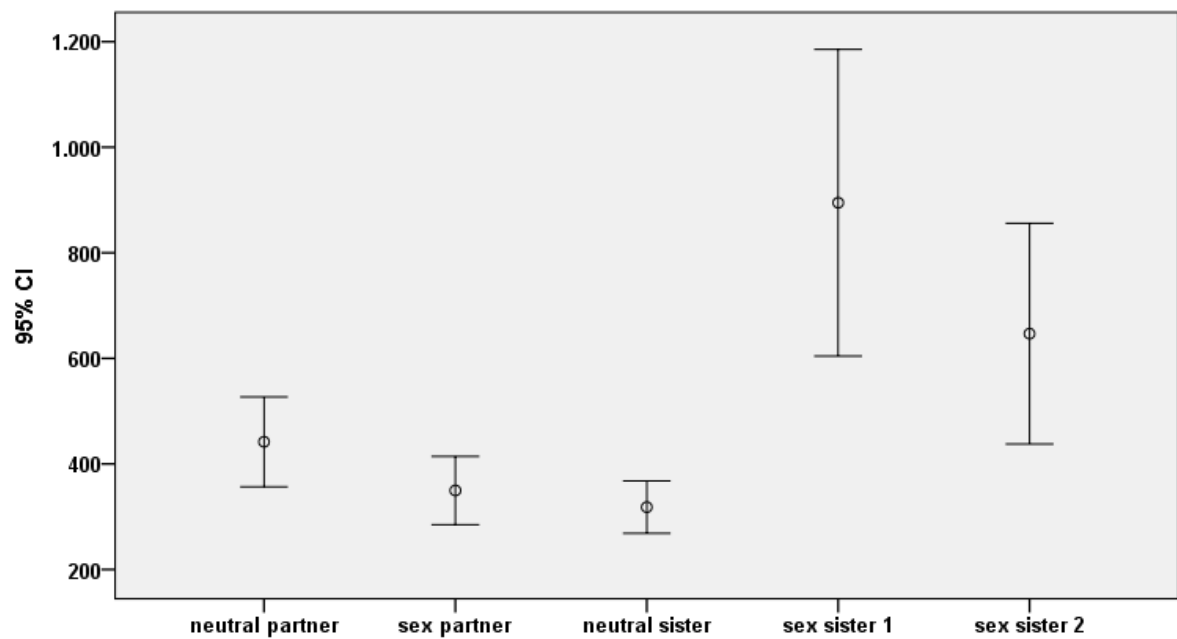


Figure 9 Error bars (mean and 95% mean C.I.) of EMG responses in males (N=66)

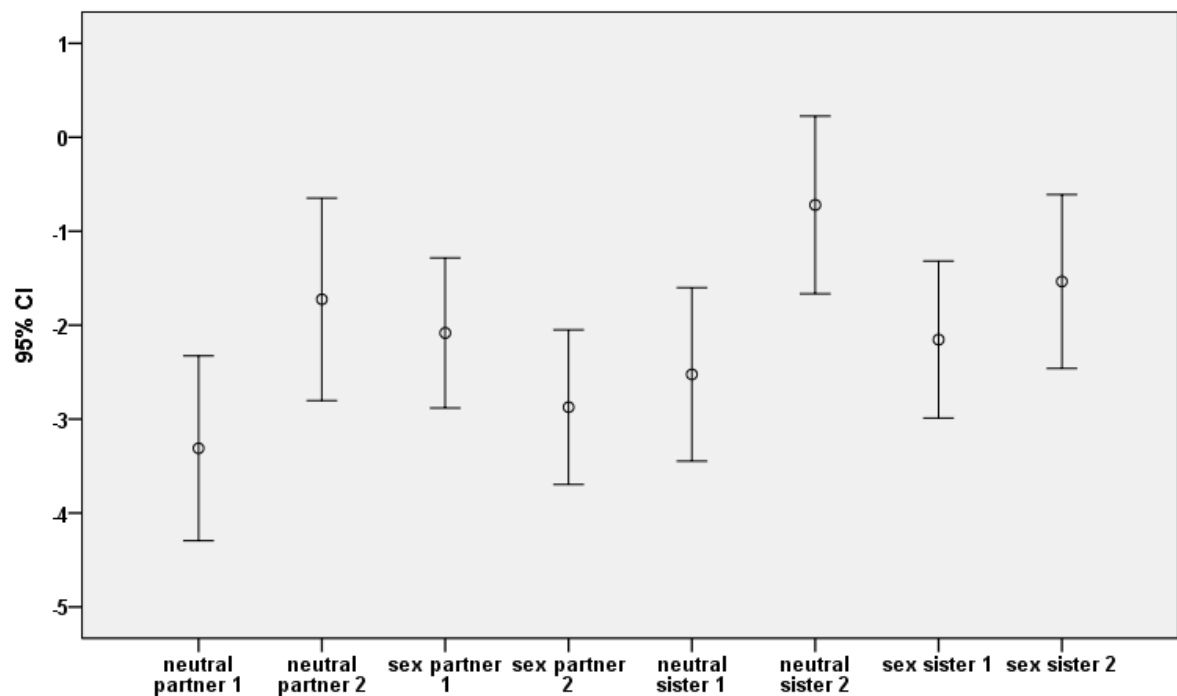


Figure 10 Error bars (mean and 95% mean C.I.) of HR responses in males (N=66)

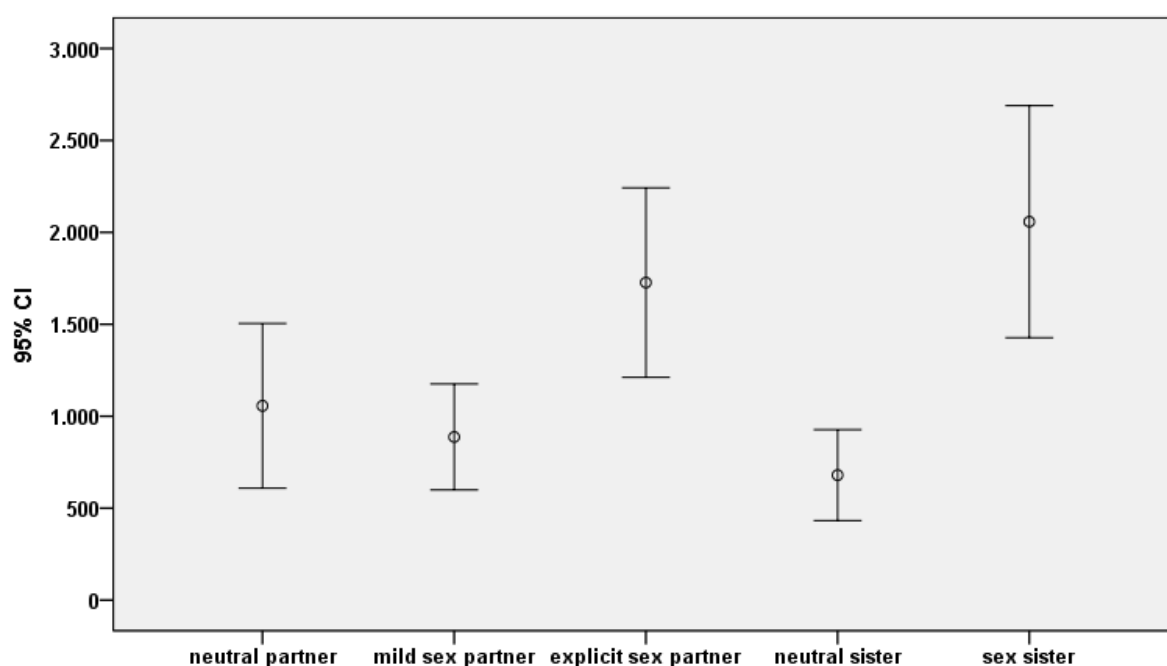


Figure 11 Error bars (mean and 95% mean C.I.) of SCR responses in males (N=66)

3.3 Results

3.3.1 Descriptive information on oldest opposite-sex sibling

The oldest brother of females (i.e., the brother sex was imagined with) was in 14% of the cases a genetically unrelated brother, in 12% of the cases a halfbrother (3% maternal halfbrother, 9% paternal halfbrother), and in 74% of the cases a full brother. Males imagined sex with a genetically unrelated sister in 9% of the cases, with a halfsister in 12% of the cases (3% maternal and 9% paternal) and with a full sister in 58% of the cases. The other 21% males (N=14) did not have a sister.

Years of coresidence duration (subject's ages 0-18) with oldest opposite-sex sibling(s) did not vary much between females (Mean \pm SE = 10.90 \pm 8.05, N=104) and males (Mean \pm SE = 12.06 \pm 7.74, N=52). Both males and females reported higher frequencies for weak indicators for shared parental investment than for strong indicators for shared parental investment (see Table 10).

Table 10 Frequencies of strong (SPI) and weak (WPI) indicators for shared parental investment for oldest opposite-sex sibling.

	Females			Males		
	Mean	SD	N	Mean	SD	N
SPI¹						
0-6	3.47	2.64	104	3.54	2.70	52
7-12	2.38	1.80	104	2.27	1.63	52
WPI²						
0-6	5.34	3.86	61	5.69	3.42	52
7-12	5.48	3.07	61	5.02	3.06	52

¹ Accumulated frequencies of bathing together and sleeping in the same bedroom.

² Accumulated frequencies of playing together and quarrelling. For 43 females, data were lacking on frequency of quarrelling (i.e., the females that were gathered for the study in chapter 2). For this reason, these 43 females were not included in the analyses for ‘weak indicators shared parental investment’.

3.3.2 Gender differences in fEMG responses to imagined sex with an opposite-sex sibling

There were no significant gender differences in fEMG responses to imagined sex with an opposite sex sibling (fEMG 1: $t(168) = .39, p = .698$; fEMG 2: $t(168) = .09, p = .938$).²

3.3.3 Critical tests: females

The brother with whom sex was imagined was younger than 47 females and older than 53 females (1 missing data and 3 brothers of the same age). Only nine of the 47 females who imagined sex with a younger brother (i.e., 19%) did not experience MPA with that brother. Therefore, subjects were split up into an MPA absent subsample (including subjects who imagined sex with a brother of the same age) and an MPA present subsample. MPA absent females and MPA present females did not differ in fEMG responses to imagined sex with their brother (fEMG1: $t(98) = -.54, p = .588$; fEMG2: $t(98) = .67, p = .503$) and did not differ in average amount of coresidence duration (ages 0-18)

² To be complete, we also report on average gender differences in HR and SCR responses to imagined sex with an opposite sex sibling. This test includes all females participating in the study reported in the previous chapter and all males included in this study (total N= 131). An independent samples t-tests showed no differences in HR (for simplicity, responses were averaged over mild and explicit, and first and second interval responses) ($t(126) = .60, p = .551$). However, a significant difference was found in SCR (for simplicity, responses were averaged over mild and explicit sex) ($t(120) = 3.70, p = .000$). Imagined sex with an opposite-sex sibling elicited larger SCR responses in males (Mean \pm SE = 1809.66 \pm 210.16) than in females (Mean \pm SE = 817.94 \pm 166.85). However, males’ SCR responses were larger than females’ for all scenarios (sex with partner: $t(118) = 2.82, p = .006$; neutral activity with partner: $t(104) = 3.42, p = .001$; neutral activity with opposite-sex sibling: $t(106) = 2.83, p = .006$).

with this brother ($t(98) = -1.16, p = .251$). MPA present females reported higher average frequencies of both WPI (at ages 0-6: $t(98) = -2.19, p = .031$; at ages 7-12: $t(98) = -3.29, p = .001$) and SPI (at ages 0-6: $t(98) = -2.90, p = .005$; at ages 7-12: $t(98) = -3.45, p = .001$). Critical tests were separately performed on each of both subsamples. Results are reported in Table 11.

In MPA absent females, the only reliable predictor of fEMG responses was again coresidence duration. Only significant or nearly statistically significant correlations could be obtained for first interval fEMG responses. Results show no significant association between fEMG responses and genetic relatedness, WPI, SPI or openness towards sexuality in the family. There is no indication that coresidence during early childhood (ages 0-6) would be of special importance for later expressed sexual aversion for a brother.

In MPA present females, increased coresidence duration tended to be associated with lower first interval fEMG responses. As for the effects of genetic relatedness: only 1 MPA present female imagined sex with a halfbrother and none of the MPA present females imagined sex with a stepbrother. As a result, critical tests for genetic relatedness could not be performed. There was no relation between WPI and fEMG responses. SPI 0-6 and SPI 7-12 positively correlated with fEMG responses to imagined sex with that brother. Also openness towards sexuality in the family was positively associated with fEMG responses.

Looking into more detail at the results of MPA present females, we found that SPI 0-6 and SPI 7-12 did not intercorrelate ($r = .10, p = .550, N = 38$). Openness towards sexuality in the family at ages 0-12 correlated with SPI 0-6 ($r = .62, p = .000, N = 38$) but not with SPI 7-12 ($r = .20, p = .232, N = 37$). When SPI 0-6 and openness towards sexuality in the family 0-12 were put into a forward linear regression model to predict fEMG1 responses, openness towards sexuality in the family 0-12 was retained as the only independent predictor ($\beta = .39$, unstandardized $B = 148.23, p = .019, R^2 = .15$). For 2nd interval fEMG responses, when SPI 0-6 and 7-12, and openness towards sexuality 0-12 were put into a forward linear regression model, SPI 7-12 was retained as the only independent predictor ($\beta = .34$, unstandardized $B = 72.63, p = .042, R^2 = .11$).

Table 11 Females: Bivariate correlations between fEMG when imagining sex with a brother and (1) coresidence duration with oldest brother, (2) genetic relatedness with oldest brother, (3) cues for shared parental investment with oldest brother and (4) openness towards sexuality in the family

	MPA = 0°						MPA = 1°					
	fEMG1			fEMG2 ²			fEMG1 ¹			fEMG2 ¹		
	r	p	N	r	p	N	r	p	N	r	p	N
CO-RES												
0-18	.23	.067	66	.13	.325	64	-.30	.070	37	-.22	.193	38
0-3	.25*	.045	66	.08	.532	64	-.30	.069	37	-.21	.206	38
0-6	.23	.062	66	.06	.660	64	-.35*	.033	37	-.22	.178	38
7-12	.27*	.028	66	.20	.115	64	-.30	.067	37	-.25	.137	38
R	.16	.199	66	.13	.293	64	n/a	n/a	n/a	n/a	n/a	n/a
WPI												
0-6	.08	.616	40	.02	.900	38	.08	.738	19	.12	.627	19
7-12	.21	.194	40	.21	.216	38	.21	.378	19	.05	.828	19
SPI												
0-6	.12	.353	66	.21	.101	64	.37*	.025	37	.34*	.040	38
7-12	-.02	.900	66	.04	.768	64	.23	.167	37	.33*	.044	38
Openness sexuality family 0-12	-.02	.865	59	-.10	.446	57	.39*	.019	36	.32	.054	37
Openness sexuality family now	.05	.734	59	-.00	.976	57	.49**	.002	36	.28	.089	37

* significant at the .05 level

** significant at the .01 level

° If MPA equals 0, it means that the subject did not experience MPA with her oldest brother (i.e., the brother she imagined having sex with); if MPA equals 1, it means that the subject experienced MPA with her oldest brother (i.e., the brother she imagined having sex with).

¹ 1 EMG outlier was removed

² 2 EMG outliers were removed

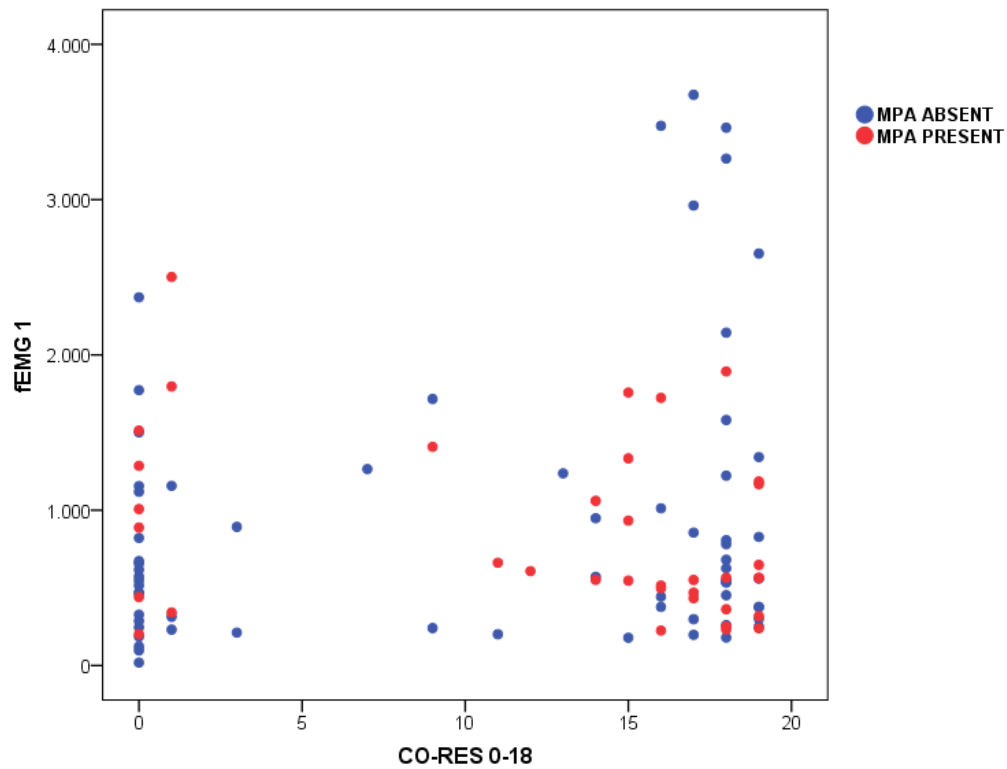


Figure 12 Scatterplot of fEMG 1 responses set out against coresidence duration with oldest brother from subject's birth until the age of 18 (female subjects)

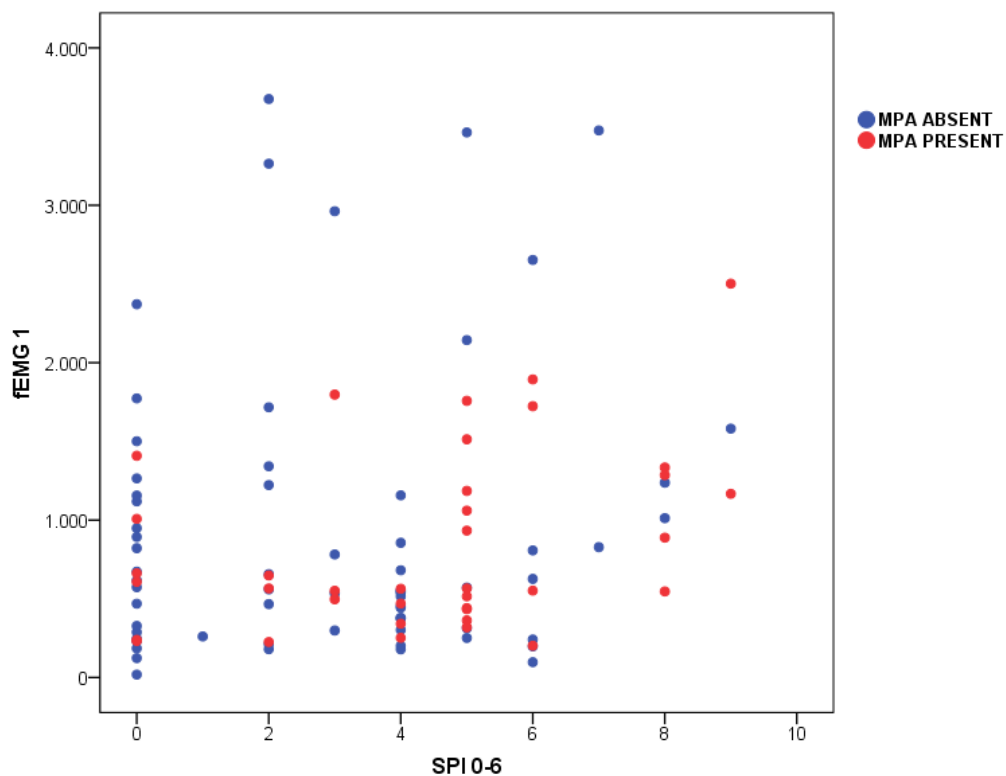


Figure 13 Scatterplot of fEMG 1 responses set out against strong predictors for shared parental investment with oldest brother from subject's birth until the age of 6 (female subjects)

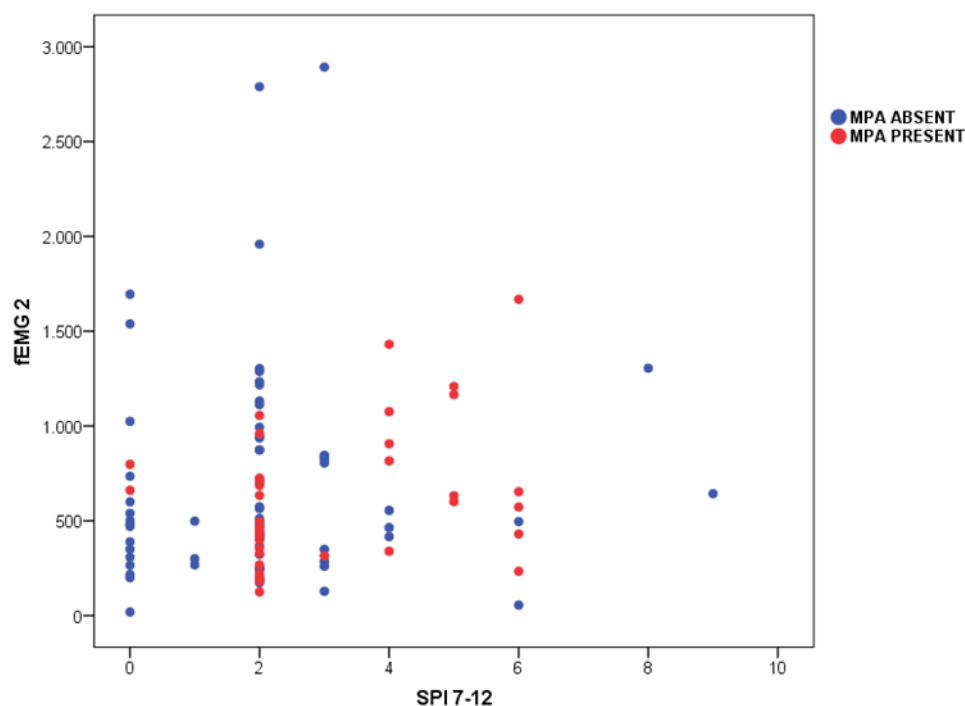


Figure 14 Scatterplot of fEMG 2 responses set out against strong predictors for shared parental investment with oldest brother between subject's ages of 7 and 12 (female subjects)

3.3.4 Critical tests: males

As attested earlier for females (see chapter 2, section 2.3.2), males indicated experiencing more success in imagining the scenarios with their partner (Mean \pm SE = 5.92 \pm 0.73, N = 62) than with their sister (Mean \pm SE = 3.94 \pm 1.50, N = 62). Males with a sister (Mean \pm SE = 3.79 \pm 1.42, N = 48) did not perform better at imagining the scenarios with sister than those without sisters (Mean \pm SE = 3.98 \pm 1.54, N = 14).

Attitudes in the family towards sexuality/nudity/physical privacy during childhood was associated with fEMG1, but not with fEMG2 (see Table 12). Such attitudes in the family at present were not associated with fEMG responses. 33% of males reported remembering being told by their parents that sexual contact between family members is inappropriate. As in females (see chapter 2, section 2.3.3), this measure did not correlate with fEMG responses to incest scenarios. Again as in females (see chapter 2, section 2.3.3), self-report measures for disgust sensitivity in males did not correlate with facial disgust expressions when imagining sex with an opposite-sex sibling.

52 males reported to have at least one sister and 14 males reported not to have sisters. fEMG responses to imagined sex with a sister did not differ between males with

and without a sister (fEMG1: $t(58) = -.73, p = .471$, 2 outliers removed; fEMG2: $t(59) = -.47, p = .641$, 1 outlier removed).

The sister with whom sex was imagined was younger than 19 males and older than 32 males (1 missing value). Only three of the 19 males who imagined sex with a younger sister (i.e., 16%) did not experience MPA with that sister. Therefore, as with the females, subjects were split up into an MPA absent subsample and an MPA present subsample. MPA absent males had significantly lower fEMG1 scores than MPA present males ($t(48) = -2.47, p = .017$, 2 outliers removed), but both groups did not differ in fEMG2 scores ($t(49) = -.72, p = .475$, 1 outlier removed). MPA present males experienced significantly longer coresidence duration than MPA absent males ($t(50) = -2.44, p = .018$). As in females, MPA present males reported significantly higher average frequencies than MPA absent males for almost all probed sibling experiences (WPI 0-6: ($t(50) = -1.60, p = .116$; WPI 7-12: ($t(50) = -2.91, p = .005$; SPI 0-6: ($t(50) = -.75, p = .087$; SPI 7-12: ($t(50) = -3.37, p = .001$). Critical tests were again performed separately on each of both subsamples. Results are reported in Table 13.

For MPA absent males we observed negative effects for each of the predictors: coresidence duration, WPI and SPI. For fEMG1, co-res 0-18, WPI 0-6 and SPI 7-12 reached or approached statistical significance ($p < .05$). Co-res 0-18 significantly correlated with both WPI 0-6 ($r = .76, p = .000, N = 36$) and SPI 7-12 ($r = .42, p = .011, N = 36$). WPI 0-6 and SPI 7-12 also intercorrelated ($r = .61, p = .000, N = 36$). When putting these into a forward linear regression model, SPI 7-12 was retained as the only independent predictor ($\beta = -.44$, unstandardized $B = -231.90, p = .010, R^2 = .19$). For fEMG2 the factors that reached statistical significance were WPI 0-6 and SPI 0-6. These factors intercorrelated significantly ($r = .57, p = .000, N = 36$). When putting these into a forward linear regression model, SPI 0-6 was retained as the only independent predictor ($\beta = -.42$, unstandardized $B = -107.49, p = .013, R^2 = .17$).

For MPA present males, effect sizes of each of the predictors also tended to be slightly negative, but none of the effects reached statistical significance.

Table 12 Males: Bivariate correlations between EMG measurements and openness towards sexuality in the family and disgust sensitivity

	fEMG1 ¹			fEMG2 ²		
	r	p	N	r	p	N
Openness sexuality family 0-12	-.25*	.049	64	-.19	.139	65
Openness sexuality family now	-.13	.315	64	.02	.868	65
parental instruction incest	-.03	.835	59	-.15	.259	60
DS-R	-.05	.715	60	-.10	.455	61
TDDS	-.10	.455	60	-.05	.700	61
sexual disgust (TDDS)	-.11	.429	58	.00	.983	59

¹ 2 EMG outliers were removed

² 1 EMG outlier was removed

Table 13 Males: Bivariate correlations of EMG measurements and (1) coresidence duration with oldest sister, and (2) cues for shared parental investment with oldest sister

	MPA = 0°						MPA = 1°					
	fEMG1 ¹			fEMG2 ²			fEMG1			fEMG2		
	r	p	N	r	p	N	r	p	N	r	p	N
CO-RES												
0-18	-.32	.068	34	-.18	.315	35	.10	.707	16	.03	.905	16
0-3	-.26	.142	34	-.25	.146	35	-.18	.515	16	-.18	.517	16
0-6	-.30	.081	34	-.18	.303	35	-.06	.838	16	-.17	.523	16
7-12	-.24	.172	34	-.12	.500	35	.17	.525	16	.08	.780	16
WPI												
0-6	-.34*	.049	34	-.39*	.020	35	.14	.595	16	-.18	.509	16
7-12	-.23	.185	34	-.21	.227	35	-.13	.625	16	-.12	.652	16
SPI												
0-6	-.26	.142	34	-.42*	.013	35	-.09	.737	16	-.36	.173	16
7-12	-.44*	.010	34	-.24	.163	35	-.09	.739	16	-.39	.139	16

* significant at the .05 level

° If MPA equals 0, it means that the subject did not experience MPA with his oldest sister; if MPA equals 1, it means that the subject experienced MPA with his oldest sister.

¹ 2 EMG outliers were removed

² 1 EMG outlier was removed

3.4 Discussion

In this study, male and female young adults imagined performing sexual and non-sexual activities with an opposite-sex sibling on the one hand and ones partner on the other, during which one or more physiological responses were registered (males and females: facial electromyography in the *m. levator labii* region; for males also skin conductance response and heart rate). The experiment provided a direct replication of the study reported in chapter 2. Again, fEMG showed to be the most interesting parameter, by displaying a distinctly stronger response pattern during imagined sex with opposite sex sibling, in comparison to all other scenarios (i.e. imagined neutral activities and imagined sex with partner).

The first specific aim of this study was to clarify the potential effects of shared experiences with opposite-sex siblings during childhood that are indicative of shared parental investment. This aim built on earlier findings obtained in the study described in the previous chapter. We mainly sought to adequately test this in female subjects by gathering additional data using the same experimental design.

Contrary to our predictions, these experiences were not associated with fEMG responses in MPA-absent females. For these females, again, coresidence duration seemed to be the only predictor showing a trend in predicting fEMG responses. In other words, the fEMG method does not allow finetuning the previously attested effects of coresidence duration using cues for shared parental investment. Interestingly, however, we found that the more often MPA-present females reported such experiences with their brothers, the stronger their facial disgust responses turned out when imagining sibling sex. Moreover, for 2nd interval fEMG responses, these effects showed to be independent of parental attitudes towards sexuality during childhood. These results suggest that, even when close perinatal association was observed between one's mother and another child, cues that point to shared parental investment during childhood may provide additional kinship information to MPA present females. While these females seemed to be attuned to go looking for cues for shared parental investment (beyond the time of perinatal association), the specific cues that MPA absent females go looking for during time of coresidence remain locked into an empirical black box. Our results did not indicate that this mechanism basically relies on the same principle as MPA, i.e. gathering information that points to shared parental investment.

Our second aim for this study was to test for gender differences in facially expressed incest aversion, as predicted by parental investment theory (Trivers, 1972). This theory posits a gender-based unbalance in reproductive costs, with females investing more in offspring than males. Indeed, previous research attested that females reporting to experience stronger aversion to suggested incest than males (see section 1.2.2.2 above). In contrast with these findings based on self-reports, our results did not attest gender

differences in fEMG responses to imagined incest. This contradicts predictions based on parental investment theory, but aligns with previous studies that investigated gender differences in facially expressed disgust. Vrana (1993) already reported an absence of gender differences in *levator labii* activity when subjects imagined disgusting situations (however, all unrelated to sexuality). This was again confirmed by Yartz and Hawk (2002) who showed subjects images of scenes that typically elicit disgust (again however, not related to sexuality). Stark et al. (2005) as well reported a general absence of gender differences in expressed facial disgust towards, for example, decayed food. More in general, while women may report stronger subjectively experienced disgust than men towards an array of typical disgust elicitors, this is not necessarily accompanied by a stronger physiological response pattern, including activity in the *levator labii* nor, for instance, heart rate (see Rohrmann et al., 2008). The observable differences in affectively experienced disgust, but equal strongness in facially expressed disgust cannot be attributed to morphological differences, since men and women have been shown to have equal facial musculature (e.g. muscular thickness) when it comes to the *levator labii* region (see McAlister et al., 1998). Therefore, as suggested by Vrana (1993), emotional subjective inner states, physiological responses and behavioural tendencies potentially function independent of each other, at least in part (see, e.g., also de Jong et al., 2011).

Research has suggested that the different sexes might be specialized in the communication of specific emotions (Schmidt & Cohn, 2001). Men for instance have been shown to be better at nonverbally communicating anger, while women seem to be better at nonverbally communicating happiness (Coats & Feldman, 1996). Both Vrana (1993) and Rohrmann et al. (2008) have theorized that this might have to do with a larger social acceptance of facial emotional display in different genders when it comes to specific emotions. As for disgust, Skolnick et al. (2013) demonstrated that gender role expectations of disgust towards pathogen-disgust elicitors suggest expectancies of stronger experience and expression in women than in men. However, we could not find any study that testing gender role expectations for the experience and expression of sexual disgust.

On the other hand, Tybur et al. (2011) empirically demonstrated that men and women tend to differ in affectively experienced disgust sensitivity, and largest differences have been observed for sexual disgust in specific. This has been suggested to be related to different costs between the sexes related to sexual threats (e.g., women face higher chance of STD transmission and risk pregnancy). If this is the case, then, assuming that the facial disgust expression has a functional role in communicating sexual disinterest (cf. Tybur et al., 2013), one would also expect to find stronger facially expressed disgust towards sexual stimuli (e.g. oral sex, incest) in women than in men. In this experiment, this could not be attested for incest. In any case, there is a need for more empirical research investigating sex differences in facial expressions of disgust towards sexual

stimuli, and its relation to gender role expectancies. As a more general recommendation, future empirical research should aim to further clarify the relationship between the facially expressive, broader behavioural and subjective inner state components of emotional experiences. Such research efforts could help us interpret the lack of gender differences in facial disgust towards imagined incest, beyond the level of mere speculation. We return to this topic in the conclusion of part 1.

The third and last aim specific to this study was to test whether the results that were reported in chapter 2 for women could be replicated for men. In other words, we predicted to find a significant positive association between coresidence duration and displayed facial disgust when imagining sex with a sister in MPA absent men, but not in MPA present men. Contrary to these predictions, in MPA absent men, the effects of coresidence duration went into the opposite direction (with moderate effect sizes), suggesting a negative association with facial disgust while imagining sexual contact with a sister. The same negative effects were found for weak and strong indicators of shared parental investment (again with moderate effect sizes). Overall, however, only on a few occasions these effects reached statistical significance. Linear regression models indicated that SPI 0-6 and SPI 7-12 are the explanatory variables for these negative effects on, respectively, fEMG2 and fEMG1 responses. In MPA present men, none of the predictors reached statistical significance.

These findings in MPA absent men strike us as very odd, since they run counter to most findings reported in the past, who showed for males either positive associations between coresidence duration and self-reported incest aversion (e.g. without making distinction between MPA absent and present: Lieberman et al., 2003, Fessler & Navarrete, 2004; only when MPA is absent: Lieberman et al., 2007) or no association (e.g. when MPA is present: Lieberman et al., 2007; without making a distinction between MPA absent and present: Royzman et al., 2008). However, linear regression analyses indicated that strong cues for shared parental investment were carrying the effects, not coresidence duration itself. As ‘strong cues for shared parental investment’ were the summed frequencies of bathing with a sister and sleeping in the same bedroom (i.e. involving being exposed naked to each other and/or in close physical contact), we can posit that our results align with those reported by Bevc and Silverman (2000). In their male-dominated subject pool (i.e. 103 males and 67 females), participants who had post-pubertal sexual experience with a sibling reported higher frequencies of seeing each other naked during childhood. Their results were never explored into more detail by later research, but now seem to be replicated by males’ facial disgust responses towards imagined sex with a sister.

However, from a evolutionary psychological computational point of view it seems unlikely that a cue for sibling relatedness used by MPA present females would evoke the opposite effect in MPA absent males. Therefore, we considered an alternative explanation for our findings in males. Could it be possible that in males, the reported

frequencies of bathing together and sleeping in the same bedroom as a sister were nothing more than proxies of parental sexual prudishness? Potentially, the more sexually prudish the parent(s), the less likely that siblings of a different gender are being bathed together, for instance. Such prudishness would probably also correlate with stronger educational emphasis on the moral wrongness of too close a physical (and sexual) contact between family members. In line with this interpretation, we found that more openness in the family towards sexuality/nudity/physical closeness during males' childhood (from birth until the age of 12) was associated with lower fEMG 1 responses towards imagined incest. This would suggest that males' facial disgust responses towards imagined sex with a sister are indeed better predicted through parental attitudes than kinship cues. This contrasts with findings based on self-report measures reported by Lieberman et al. (2003). They reported that perceived parental attitudes towards sexuality did not independently predict subjects' moral attitudes regarding third party sibling incest. Additional research should thus further clarify the relationship between male incest aversion and parental attitudes. Potentially, a more direct capture of parental attitudes towards sexuality could be a more reliable measure than subjects' *perceived* parental attitudes (which were the measures for analysis in both Lieberman et al. 2003, and the study described here).

In conclusion, our study confirms that fEMG is a fine-grained tool for the study of incest avoidance in males and females, and provides us with an additional way to test theoretical evolutionary predictions. This study provides evidence that experiences with opposite-sex siblings that are indicative for shared parental investment might additionally predict incest aversion in MPA-present females.

For the next chapter, we took the fEMG approach one step further, by investigating whether a disgust response can be generated when incest is not even explicitly mentioned but merely suggested by using a priming technique. By doing this, we wished to test how deeply the sexual aversion for incest is embedded into our psychology.

Chapter 4 Can sexual aversion for incest be implicitly primed?

4.1 Introduction

In the previous two chapters we reported studies which investigated the relation between cues for sibling detection and facially expressed disgust when imagining sex with a sibling. In this final chapter of part 1, we pursued our interest for sexually aversive responses to incest. We conducted another empirical study that again tested the activity in the *levator labii* region, but this time however in response to the subtle suggestion of sexual contact with or between family members. In other words, we wished to ascertain whether there is an increased activity in facial muscles responsible for the expression of disgust when ‘incest’ is not actually mentioned, but merely suggested by the presentation of stimuli related to ‘family’ on the one hand and ‘sex’ on the other. Naturally, it would be highly interesting if it were possible to attest in this case a heightened activity in the *levator labii* region, as this would indicate that the sexual aversion for incest is so deeply embedded into our psychology that even its mere suggestion can bring about the corresponding appropriate emotional output (i.e. an aversive response). Below, we start by providing some background information regarding the method that will be used to assess implicit sexual aversions for incest.

In psychology, priming is widely used test for the effects of a sensory (visual, sound, etc.) stimulus on the subsequent behavior or emotional state of a test subject. In particular, researchers are often interested whether the stimulus’ effects take place without the subject being consciously aware of its presence. As part of an experimental procedure, a stimulus may be introduced to the environment without drawing the subject’s attention to it, for example, when displaying images of eyes in a coffee room, to test for increases in voluntary money contributions (Bateson et al., 2006). In a laboratory setting, researchers often test for the effects of visual cues which are supraliminally primed (i.e. displayed long enough to be consciously perceived) or subliminally primed (i.e. so short that they cannot be consciously perceived).

This way, priming by visual cues, has been shown to influence both behavior and emotional response in the domain of disgust. Lundqvist and Dimberg (1995) for instance reported that priming by images of facial disgust expressions (supraliminal, for 8 seconds) evokes higher activation in the *levator labii* (i.e. facial mimicry) and higher self-reported levels of experienced disgust (i.e. emotional contagion), compared with priming by neutral facial expressions. Also, when primed by faces that express disgust (or by disgusting images, or even by the word ‘disgust’) at the subliminal level, subjects categorize disgusting images more quickly into the category of ‘disgusting’ than fearful images into the category of ‘fearful’ (Neumann & Lozo, 2012). Recently, Wagenbreth et al. (2014) reported that priming subjects (for 150 ms) with merely the eye region of fear or happiness expressions created congruence and incongruence effects during a subsequent lexical decision task.¹ Trials that included priming by happiness or fear expressions, entailed faster decisions when the subsequent word target did not refer to the specific emotion (i.e. an incongruent prime-target condition) compared to when the subsequent word target referred to the emotion prime (i.e. a congruent prime-target condition). Interestingly, however, primes exposing the eye regions of facial disgust did not affect congruency/incongruency performance during the lexical decision task, suggesting that in case of facial disgust, people derive the emotional information from other facial parts, such as the mouth expression. This aside, and overall, priming with disgust-related visual stimuli (e.g. whole facial expressions), even at the subliminal level, evokes mimicking facial expressions, corresponding underlying emotional states, and a congruence effect when asked to classify subsequent emotionally congruent and incongruent targets.

In this experiment, we did not aim to test whether (subliminal) priming with ‘incest’ (e.g. the word itself) would bring about similar effects as described above. Given the attested effects with a broad array of disgust-related visual stimuli, found throughout the literature, we cautiously speculate that it would. Instead, we aimed to test whether presenting subjects with concepts related to ‘family’ (i.e. without explicitly mentioning incest) alters responses to subsequently presented depictions of sexual acts. Responses that were measured are the activity in the *levator labii* region (facial expression of disgust) during sexual stimulus presentation, and subjectively reported enjoyment of the sexual stimulus immediately after image display.

Several alternative ways were considered for priming subjects with the concept of ‘family’, e.g. using images or names of subjects’ specific own family member(s), or family-related nouns to be used identically across all subjects. Also, both subliminal and supraliminal priming were considered. Research as early as 1986 has suggested that

¹ For more information on the lexical decision task, see below.

priming (for 250 ms) with either familiar names or faces enable access to semantic information about a person's identity (Bruce & Valentine, 1986). Subjects classified familiar faces more quickly into the category of 'familiar' (vs. 'unfamiliar') after being primed with the face of an associated individual (e.g. Laurel, of the comic duo, followed by Hardy) vs the face of an unassociated individual. In a separate experiment, this effect was replicated for familiar names (preceded by the names of associated vs. unassociated individuals).

Recent research suggests that very shortly presented faces and names of familiar individuals may affect emotional valence evaluations of subsequently presented targets (see below). However, its specific effects seems to depend on the priming technique ('masked'² vs. 'unmasked'³), as well as on the stimulus (word vs. face). In a within-subjects design, Banse (1999) primed subjects with the first names and faces of either a friend, their romantic partner or themselves (each presented for 10.5 milliseconds), and this either masked or unmasked. In the masked priming condition, names or faces of friends and romantic partners increased positive evaluations of emotionally neutral items (i.e. Chinese letters), compared to subjects' own name or face primes. In the unmasked priming condition, faces (but not names) of friends and romantic partners had the same effect. In a later study (Banse, 2001), subjects being primed with the face or name of a well-known sympathetic person (i.e. Charlie Chaplin) via the unmasked technique classified positive words faster into the 'positive' category than negative words in the 'negative' category, compared to being primed with the face or name of a well-known antipathetic person (i.e. Saddam Hussein). However, when the researchers used the same stimuli in a masked priming design, the opposite effect was found. In other words, identity derived from faces and names seems to be implicitly processed, but its effects are not straightforward. Moreover, subliminal priming remains a highly controversial topic when it relates to higher-order computational processing in general (for a critical review paper see Kouider & Dehaene, 2007). Given the methodological issues with subliminally presented primes in general, and of familiar faces and names in particular, we decided to proceed with a supraliminal priming design, which means that subjects are presented with the prime stimulus long enough for it to be consciously perceived and processed.

The remaining choice to be made was using images or names of subjects' own family member(s), or using general family-related nouns. Opting for personalized stimuli would have substantially increased the preparation workload (i.e. such an experimental

² In masked priming, the prime is preceded or followed by a composite image (e.g. a scrambled face or pattern mask containing letters) that functions to additionally prevent processing at the conscious level.

³ In unmasked priming, the prime is preceded and followed by a blank screen.

set-up requires customized programming for each subject, and in case of images, all subjects need to bring images of close family members to the lab), which may have created additional practical issues (e.g. assuring neutral background settings and neutral facial expressions across images). The decision to be made revolved around the question whether using the names or images of subjects' own family members is expected to be required for a successful priming effect. In line with the Burton, Bruce and Johnston (1990) model, which is still considered to be a fundamental conceptual model in the current literature on person priming (see Wiese, 2011), the presentation of faces and names essentially provides access to stored identity-specific semantic information. Johnston and Barry (2006) discuss what kinds of semantic information can be expected to be accessed by priming with names or faces. It is suggested that certain biographical features which are common to subclasses of people become abstracted, providing the advantage of economy of storage, and enabling an efficient processing of similarities between people, e.g. race or age. Importantly for our design, it has been shown that family or 'kinship' is a fundamental concept in social categorization: kinship is one of the categories that our mind uses to carve the social world (Lieberman et al., 2008). Accordingly, we assume that priming with the faces or names of related individuals (e.g. one's mother, one's father, one's sibling, etc.) will give access to the concept of 'family', as well as priming subjects with general words that refer to family (e.g. 'mother', 'father', 'sister', 'brother'). Moreover, we were unable to find any published study indicating that subject-specific stimuli (e.g. given names of subject's family members) trigger associations with 'family', while non-personalized stimuli (e.g. word items such as 'brother', 'father', 'mother') do not.

For the reasons described above, we decided to work with general word primes that refer to family members, with the advantage that these can be used identically across all subjects. We contrasted this 'priming with family' condition with a 'priming with non-family' condition, which included words referring to individuals who are not family related, such as 'neighbor' and 'teacher' (see methods section for an overview of the stimuli). In order to disguise the priming procedure, priming words were presented in the format of two cognitive decision tasks. The first format made use of a classic lexical decision task. In this task, which is a widely used procedure in psychological research, real and gibberish words are presented one by one to the subjects, who then have to decide as quickly and as accurately as possible whether the word is real or not. We opted to work with two blocks: one block in which the gibberish words were combined with real words that are all related to family members, and one block in which the gibberish words were combined with real words that do not refer to family members (see methods section below). Words were presented on the screen in a random order, and with the distribution of 90% real and 10% gibberish words. The second format made use of a classic semantic categorization task, which is, again, a widely used procedure in psychological research. In this task, words, which are again presented one by one, have

to be sorted as quickly and as accurately as possible into their appropriate category. In our design, these categories were ‘family’ and ‘not family’. Here the design only included one block, in which words referring to family members and words that are not are presented on the screen in a random order and with an equal distribution (50/50). So, the two tasks differ from each other in two ways: the instruction procedure and the presentation procedure (single blocked versus 2-blocked). We would argue that the priming procedure in the lexical decision task is slightly more subtle, since its instructions do not explicitly put subjects’ attention to ‘family’: they are asked to identify which words are real and which are not. In contrast, during the semantic categorization task subjects are explicitly instructed to judge whether each word refers to ‘family’ or whether it doesn’t. This procedure puts explicit attention to the semantic difference between the stimuli. The approach also allowed us to test whether priming ‘family’ and ‘not-family’ might have a differential impact in a 2-blocked design (i.e. when the task either primes for family or for not-family) versus a single-blocked design (i.e. when family and not-family are alternately being primed during the same task run).

The target items depicted intimate/sexual activities involving a man and a woman. As our control items, we chose images that either displayed pathogen cues (e.g. feces), sexual activities involving two men, or a non-sexual and non-pathogen related ‘neutral’ stimulus (see also the methods section). In order to measure aversive response we registered fEMG activity in the *levator labii* region when the target image was displayed, and collected self-reported evaluations regarding the valence of each target. Figure 15 displays an overview of the method (but see also the methods section below), and indicates the differences and similarities with the imagination task that was included in the previous chapters.

Figure 15 Overview of experimental designs of fEMG studies: implicit and explicit priming of ‘incest’ and experienced aversion. For each experimental design, the time lapse, procedures and stimuli are given for one trial.

TASK		TIME (ms)	PROCEDURE	STIMULI			
Implicit priming of Incest aversion	Lexical decision Task	0-1500	(1.A) Subject decides whether the displayed word is a real word or not.	Block A		Block B	
				1 word referring to an individual who is a family member (90%)	1 gibberish word (10%)	1 word referring to an individual that is not a family member (90%)	1 gibberish word (10%)
		1500-2000	inter-stimulus interval	Fixation point			
		2000-6000	(1.B) subject passively watches an image displaying one of the following activities:	neutral	heterosexual sex	homosexual sex	pathogen
	6000-8500	Inter-trial interval	black screen				
	Semantic categorization task	0-1500	(2.A) Subject decides whether the displayed word relates to family or not.	1 word referring to an individual who is a family member		1 word referring to an individual that is not a family member	
		1500-2000	inter-stimulus interval	Fixation point			
		2000-6000	(2.B) idem 1.B	Idem 1.B			
		6000-8500	Inter-trial interval	black screen			
	Explicit priming of incest aversion	Imagination task (chapters 2 and 3)	0-3000	Announcement of new trial.	Fixation cross (1000 ms)		Black screen (2000 ms)
3000-7000			(3.A.) Subject reads the displayed instruction.	‘Imagine you do the following activity with your partner’ (50% of trials)		‘Imagine you do the following activity with your brother (females) / sister (males)’ (50% of trials)	
7000-8000			inter-stimulus interval	black screen			
8000-16000			(3.B) idem 1.B	neutral	heterosexual sex		
10000, 12000 or 14000 ms			Inter-trial interval	black screen			
Dependent Variables: fEMG responses in <i>m. levator labii</i> region during image display and image ratings: ‘very unenjoyable’ to ‘very enjoyable’ (the latter only in the lexical decision task and semantic categorization task)							

4.2 Methods

4.2.1 Participants

Participants were recruited for voluntary participation to an experimental study at the Law Faculty of Ghent University. The experiment was announced to involve a sorting task, looking at pictures with a potentially sexually explicit content, and measurement of physiological signals. Participants with a history of childhood sexual abuse were asked to refrain from participation. Subjects received a financial compensation of 10€ for participating.

Thirty-five subjects took part in the study which included the semantic categorization task. All subjects were students at Ghent University (age $MEAN \pm SD = 21.31 \pm 2.46$, 66% females), with 32 participants reporting to be heterosexual, and 3 to be homosexual.

Thirty-eight subjects took part in the study which included the lexical decision task. Again, all subjects were students at Ghent University (age $MEAN \pm SD = 20.76 \pm 2.03$, 52% females), with 32 participants reporting to be heterosexual, and 6 to be homosexual.

4.2.2 Materials

4.2.2.1 Visual stimuli

Word stimuli – In both tasks, 20 words were used, half of which referred to a specific family member (Dutch words for ‘mother’, ‘father’, ‘brother’, ‘sister’, ‘grandfather’, ‘grandmother’, ‘uncle’, ‘aunt’, ‘cousin’ (m/f)), and half of which did not refer to a family member (Dutch words for ‘neighbor’ (m/f), ‘colleague’, ‘boss’, ‘doctor’, ‘dentist’, ‘hairdresser’, ‘student’, ‘professor’, ‘mailman’). These word stimuli had been pre-tested for valence, arousal and dominance.¹ In the lexical decision task, in addition to these 20 real words, we also used 5 unique gibberish letter combinations. These gibberish words consisted of letter combinations that closely resemble Dutch words, but are nonsensical (e.g. ‘brelo’, ‘moelk’, ‘kirs’). So, for the semantic categorization task, we used 10 words

¹ For the criteria used to select word items, and a full description of the word pretest, including results, see Appendix 2.

referring to family members and 10 words not referring to family members, while the same words for family and non-family, and in addition 5 gibberish words were used for the lexical decision task.

Image stimuli – images depicted either a pathogen cue (PATHOGEN), a sexual activity between a man and a woman (HETERO), a sexual activity between two men (HOMO) or a non-sexual and non-pathogen related neutral stimulus (NEUTRAL). Neutral stimuli depicted for example a landscape or healthy looking food. Each of these images had been pre-tested on valence, arousal, dominance, the extent to which the image has a sexual character and the extent to which the image elicits disgust.² The 20 images that were selected for each category based on the results of the pre-test, were split up into two image samples (A and B). Both samples were alike in mean scores on valence, arousal, dominance, sexuality and disgust.³ In both tasks, half of the subjects were presented with the ‘family’ word stimuli combined with sample A and the ‘non-family’ word stimuli combined with sample B. The other half of the subjects was presented with the reversed combination.

The words and images, together with the appropriate instructions, were programmed into an automated computer task using Inquisit 4.0 software produced by Millisecond Software.

4.2.2.2 Psychophysiological measure

Facial electromyographic activity was recorded using a *Biopac MP150* hardware system, combined with system-specific software, *Acqknowledge version 3.8.2*. The raw signal was filtered (high pass 10Hz – low pass 500 Hz) and amplified (x 1000) using an EMG amplifier module. Data were collected at a sampling rate of 1000 samples per second. Facial EMG was measured for activity in the *levator labii* region, using a pair of 4 mm shielded Ag-AgCl electrodes, and one unshielded ground electrode. After slight skin abrasion, measurement electrodes were placed on the left side of the face, and the ground electrode was placed centrally on the forehead, following the guidelines set out by Fridlund & Cacioppo (1986).

4.2.2.3 Evaluative self-report measures

Immediately after display, each image was rated on a visual analogue scale (‘not enjoyable’ to ‘very enjoyable’) (see figure 16).

² For the criteria used to select images items, and a full description of the image pretest, including results, see Appendix 3.

³ See also Appendix 3.



Figure 16 Immediately after display, each image was rated on this visual analogue scale.

4.2.3 Procedure

Each participant was tested separately. On arrival, the participant was randomly assigned to one of the two experimental tasks (semantic categorization or lexical decision), after which he/she read an information sheet that briefly summarized the various parts of the experiment. After having provided written informed consent, the subject was connected to the physiological equipment, and accurate fEMG registration was confirmed. Next, the experimenter left for an adjacent space and the subject completed the automated computer task, which took about 20 minutes in the single-blocked design of the semantic categorization task and 2 times 10 minutes in the two-blocked design of the lexical decision task. The automated task included all stimuli and task instructions. In both tasks, each individual trial included the presentation of a word followed by the presentation of an image (see also figure 16).

In the semantic categorization task, subjects decided as quickly as possible whether the word, presented in the middle of the screen, referred to 'family' or 'not-family' by pressing either the 'E' (for 'family' words) or the 'I' key (for words not referring to family) of the keyboard. In the lexical decision task, subjects decided as quickly as possible whether the letter combination, presented in the middle of the screen, was a real word or not by pressing either the 'E' (for a real word) or the 'I' key (for a gibberish word) of the keyboard. It was explained to subjects that the stimulus would disappear either once a response was given, or automatically after 2,5 seconds (i.e. no response). After each decision/categorization or after automatic disappearance of the stimulus, participants were immediately shown an image from one of the 4 categories (NEUTRAL, PATHOGEN, HETERO and HOMO), again presented in the middle of the screen. Participants were instructed to passively watch this image. Subjects were not aware that at this very moment, facial electromyographic activity (fEMG) in the *levator labii* region was measured. After 4 seconds, the image was automatically erased from the screen. Subsequently, participants were asked to rate the image on a visual analogue scale ('very unpleasant' to 'very pleasant'). The semantic categorization task had a single-

blocked design. Participants categorized the 80 words, i.e. 40 words that referred to a family member and 40 words that did not refer to a family member.

The lexical decision task had a 2-blocked design, with the first block (44 word-image combinations) showing gibberish words (N=4) and real words referring to family members (N=40), and the second block (44 word-image combinations) showing gibberish words (N=4) and real words not referring to family members (N=40). Between the first and the second block, a brief break of about 5 minutes was included. Block order was counterbalanced in the total subject sample, meaning that half of the subjects first saw the block in which family words were combined with gibberish words, and the other half first saw the block in which non-family words were combined with gibberish words.

In both tasks, word categories (family/non-family) were combined with an equal distribution of the 4 types of images, i.e. 10 images of each type for each word category.⁴ As described above ('materials – visual stimuli'), images within each image category were split up into two samples, A and B, which did not differ in valence, arousal, dominance, disgust or sexuality. In half of the subjects, words that referred to family were combined with images of sample A and words that did not refer to family were combined with images of sample B. For the other half of the subjects, it was the other way around. Within each sample, the specific words and the specific images were randomly combined. However, each image was only shown once, and within a specific category (e.g. 'kin pathogen') priming stimuli (e.g. 'mother') were never repeated. In the lexical decision task, the gibberish words were combined with filler images (but again, with an equal distribution of the 4 types of images). Presentation order of the trials was randomized in the semantic categorization task, and randomized within the blocks of the lexical decision task.

After approximately 20 minutes the task was finished. The researcher returned and disconnected the physiological equipment, after which the subject completed a brief questionnaire asking about demographical information (e.g. age and gender), was debriefed and was financially compensated for participating.

4.2.4 fEMG data recording and preparation

Once data collection had been completed, the raw signals were processed off-line using the psychophysiological analysis (PSPHA) software program (Declercq et al., 2006). All raw data were multiplied by 200, in order to allow digital processing. When processing the data, PSPHA applies a smoothing algorithm (FIR filter). Visual inspection revealed

⁴ For a complete overview of all specific word/image category combinations, see appendix 1.

occasional ‘spikes’ (i.e. severe peak responses) in the data files of some of the participants. These artifacts were manually rejected before data analysis.

fEMG data were analyzed using the following the peak response method as described earlier (see chapters 2 and 3). The image response value was calculated by subtracting the mean baseline response (20 ms after image display) from the peak response during image display (4000 ms).

Initial storage of the relevant data pertaining to the computer task (e.g. image ratings on the visual analogue scale) was provided by Inquisit. All data (*Inquisit* and EMG) were subsequently transferred to SPSS for further analysis.

The last step of data preparation before analysis dealt with outlying observations. Outliers typically have a large influence on the outcomes of many statistical procedures. Omitting them from the analyses is justified if researchers suspect them to be the result of, for example, technical artifacts in the data, which was the case here for fEMG outliers. We defined outlying variables as responses that deviate from the $MEAN \pm 2 \times SD$ range of the specific word/image category combination to which the trial belongs (e.g. ‘brother’ + pathogen image). Visual inspection of the data distributions indeed showed outlying fEMG responses in a limited amount of trials within each specific word/image category combination. The fEMG responses of these trials were eliminated from further analysis.⁵ As a result, in the semantic categorization task, 140 trials were eliminated across all subjects (i.e. on average, 1.76 outliers per specific word/image category combination). In the lexical decision task 163 trials were eliminated spread over all subjects (i.e., on average, 2.04 outliers per specific word/image category combination).

4.2.5 Data reduction

Since our experiment collected a lot of data for each subject, several strategies were deployed in order to reduce the amount of data, and simplify further analysis.

A repeated measures ANOVA showed no significant differences in fEMG responses to heterosexual between the specific word primes for kin (i.e. ‘mother’, ‘father’, etc.), as well as no differences in responses to heterosexual between the specific word primes for not kin (i.e. ‘neighbor’, ‘student’, etc.). Also, for most other image categories, no differences in fEMG responses were found between the specific words within each priming condition. (see Table 14). For the self-reports, similar results were found (see Table 15). Given the lack of differences in responses between specific word primes within the same type of

⁵ This is an accepted way of dealing with outlying variables in the fEMG literature (see, e.g., Korb et al., 2014). Other ways to deal with outliers in fEMG responses are, for instance, square roots transformation (see e.g. Voutilanen et al., 2014) or log transformation (see e.g. Shenhav & Mendes, 2014).

prime, mean responses were calculated over ‘family’/image category combinations (i.e. family+neutral, family+pathogen, family+heterosex and family+homosex) and the same for ‘not-family’/image category combinations (i.e. non-family+neutral, non-family+pathogen, non-family+heterosex and non-family+homosex). This was carried out both for the fEMG responses and for the self-reports.

To check for block order effects in the lexical decision task (i.e. family/not-family order vs. not-family/family order), an independent samples t-test was conducted. There were no block order effects for any of the prime/image combinations (all $p > .128$).

A repeated measures ANOVA showed no overall differences in fEMG responses between the semantic categorization task and the lexical decision task ($F_{1,71} = .35, p = .559$) (see figure 17). Therefore, data of both tasks were combined in the analyses. Similarly, a repeated measures ANOVA showed no overall differences in self-reports between the semantic categorization task and the lexical decision task ($F_{1,71} = .11, p = .737$) (see figure 18). Again, data of both tasks were combined in the analyses.

Repeated Measures Analysis of Variance was used in order to test for any effects of priming condition (family/non-family), image category (neutral, pathogen, hetero and homo) and gender.

Table 14 Repeated Measures ANOVA for differences in fEMG responses between specific word primes within each priming condition (family/not family)

	Semantic Categorization task	Lexical Decision Task
Family primes (words N=10)		
Neutral	$F_{9,189} = .97, p = .469$	$F_{9,198} = 1.00, p = .445$
Pathogen	$F_{9,234} = 1.57, p = .124$	$F_{9,261} = .41, p = .929$
Hetero	$F_{9,171} = .41, p = .927$	$F_{9,198} = .90, p = .528$
Homo	$F_{9,243} = .83, p = .587$	$F_{9,243} = 1.25, p = .266$
Not Family primes (words N=10)		
Neutral	$F_{9,189} = 2.36, p = .015^*$	$F_{9,243} = .79, p = .625$
Pathogen	$F_{9,225} = 1.55, p = .133$	$F_{9,252} = 1.82, p = .065$
Hetero	$F_{9,207} = 1.12, p = .347$	$F_{9,243} = .79, p = .630$
Homo	$F_{9,225} = .89, p = .532$	$F_{9,207} = .36, p = .952$

* Significant at the .05 level.

Table 15 Repeated Measures ANOVA for differences in subjective rating responses between specific word primes within each priming condition (kin/not kin)

	Semantic Categorization task	Lexical Decision Task
Family primes (words N=10)		
Neutral	$F_{9,306} = 1.00, p = .448$	$F_{9,333} = .44, p = .915$
Pathogen	$F_{9,306} = .41, p = .932$	$F_{9,333} = 1.48, p = .154$
Hetero	$F_{9,306} = .74, p = .674$	$F_{9,333} = 1.22, p = .284$
Homo	$F_{9,306} = 1.86, p = .058$	$F_{9,333} = .91, p = .519$
Not Family primes (words N=10)		
Neutral	$F_{9,306} = .104, p = .410$	$F_{9,333} = .30, p = .975$
Pathogen	$F_{9,306} = .103, p = .417$	$F_{9,333} = .56, p = .834$
Hetero	$F_{9,306} = .76, p = .650$	$F_{9,333} = .64, p = .767$
Homo	$F_{9,306} = .79, p = .630$	$F_{9,333} = .98, p = .454$

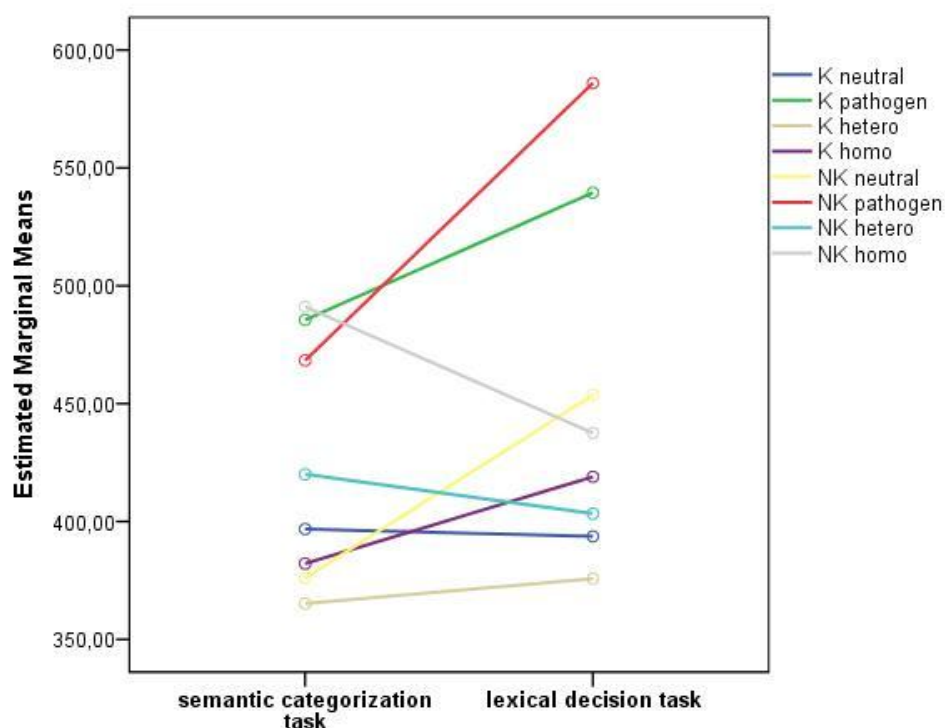


Figure 17 Mean fEMG responses towards neutral, pathogen, heterosexual sex and homosexual sex images in each experimental task. 'K' refers to images preceded by a word referring to kinship, 'NK' refers to images preceded by a word not referring to kinship.

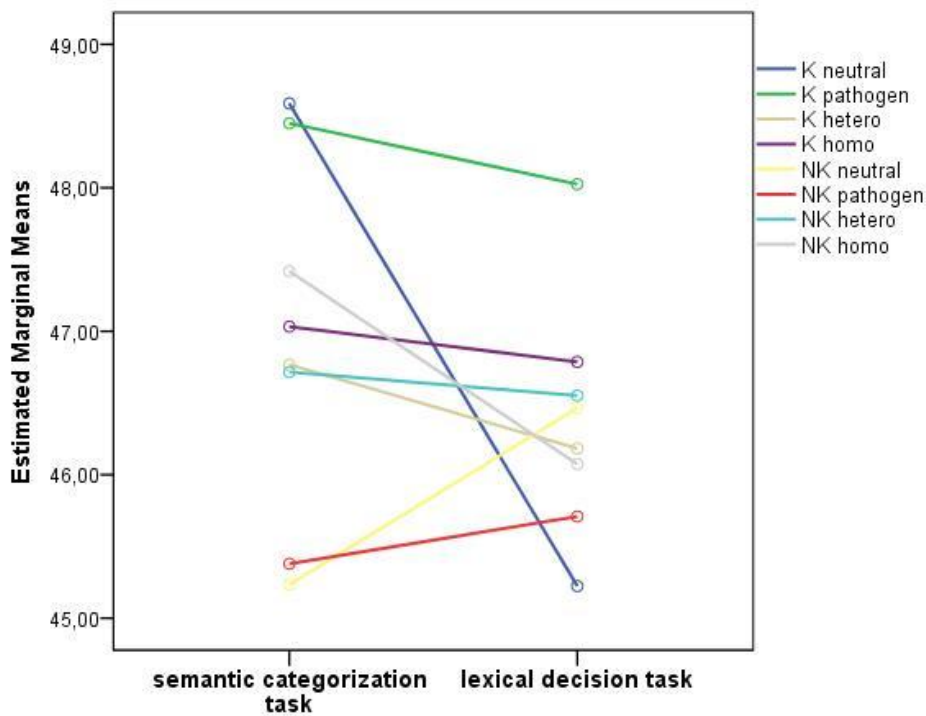


Figure 18 Mean self-report measures towards neutral, pathogen, heterosexual sex and homosexual sex images in each experimental task. ‘K’ refers to images preceded by a word referring to kinship, ‘NK’ refers to images preceded by a word not referring to kinship.

4.3 Results

4.3.1 fEMG-measured facial disgust

A two-way Repeated Measures ANOVA was calculated, with kinship (kin/not kin) and image category (neutral/pathogen/heterosex/homosex) as within-subjects factors and gender as between subjects factor. Results showed a significant main effect of image category ($F_{3,213} = 14.14, p = .000$), a significant main effect of kinship ($F_{1,71} = 6.39, p = .014$), no main effect of gender ($F_{1,71} = 1.46, p = .231$) and no interaction effects (category x kinship: $F_{3,213} = .63, p = .598$; gender x category: $F_{3,213} = .81, p = .492$; gender x kinship: $F_{1,71} = .14, p = .706$; gender x kinship x category: $F_{3,213} = 1.08, p = .358$).

Pairwise comparisons between image categories showed that pathogen images elicited significantly stronger fEMG signals than neutral (MD= 116.65, SE= 25.34, $p = .000$), heterosexual (MD= 133.64, SE= 27.18, $p = .000$) and homosexual (MD= 86.29, SE= 28.00, $p = .003$)

images. Homosex images elicited stronger fEMG signals than heterosexual images ($MD=47.34$, $SE=15.53$, $p=.003$).

The main effect of kinship showed that fEMG signals to images preceded by family primes were on average lower than fEMG signals to images preceded by primes not referring to family ($MD=34.04$, $SE=13.47$, $p=.014$).

Figure 19 displays the plot of the fEMG responses to each image category separately for each priming condition.

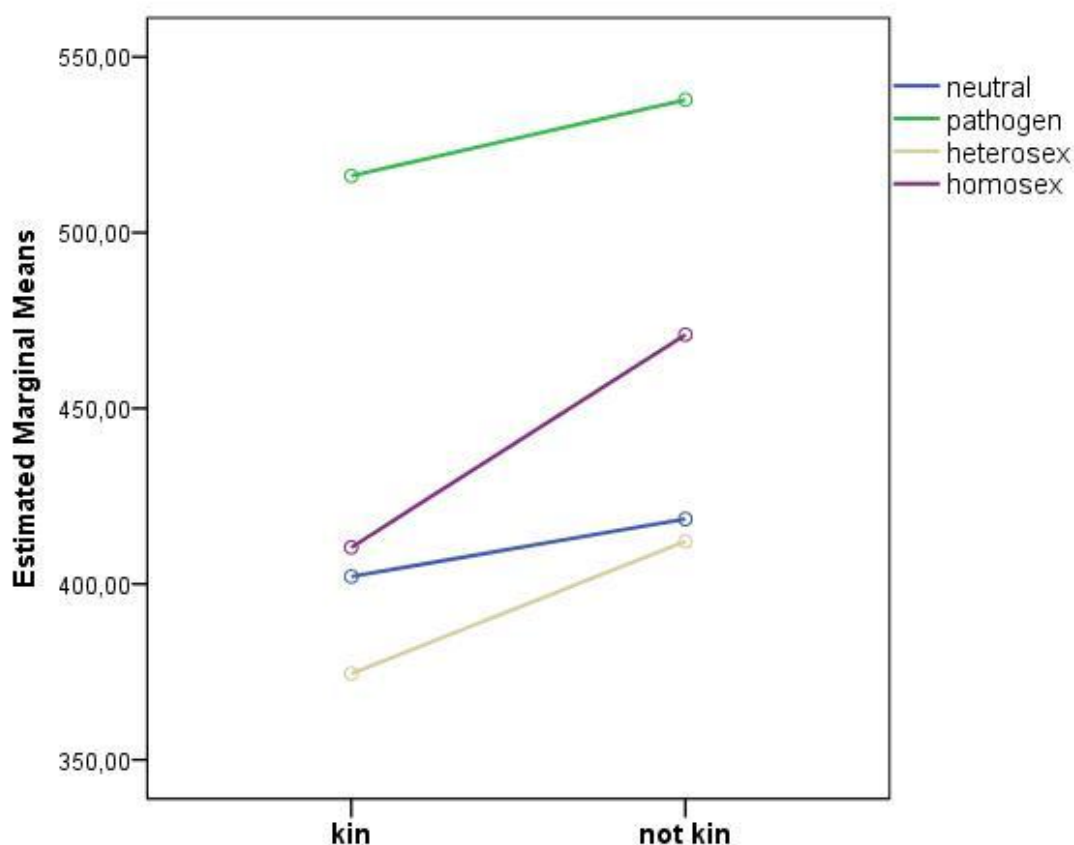


Figure 19 Mean fEMG responses towards neutral, pathogen, heterosexual sex and homosexual sex images, displayed separately for each priming condition (i.e., kinship/not kinship)

4.3.2 Self-Reports of enjoyableness

A two-way Repeated Measures ANOVA was calculated, with kinship (kin/not kin) and image category (neutral/pathogen/heterosexual/homosexual) as within-subjects factors and gender as between subjects factor. Results showed no significant main effect of image

category ($F_{3,213} = .04, p = .991$), no significant main effect of kinship ($F_{1,71} = 1.68, p = .199$), a marginally significant effect of gender ($F_{1,71} = 3.41, p = .069$) and no interaction effects (category x kinship: $F_{3,213} = .90, p = .442$; gender x category: $F_{3,213} = 2.00, p = .116$; gender x kinship: $F_{1,71} = 1.05, p = .308$; gender x kinship x category: $F_{3,213} = .30, p = .825$). The trend in the effect of gender is indicative of, on average, a more positive/less negative image evaluation in males than in females ($MD = 3.10, SE = 1.68$).

Figure 20 displays the plot of the self-report measures to each image category separately for each priming condition.

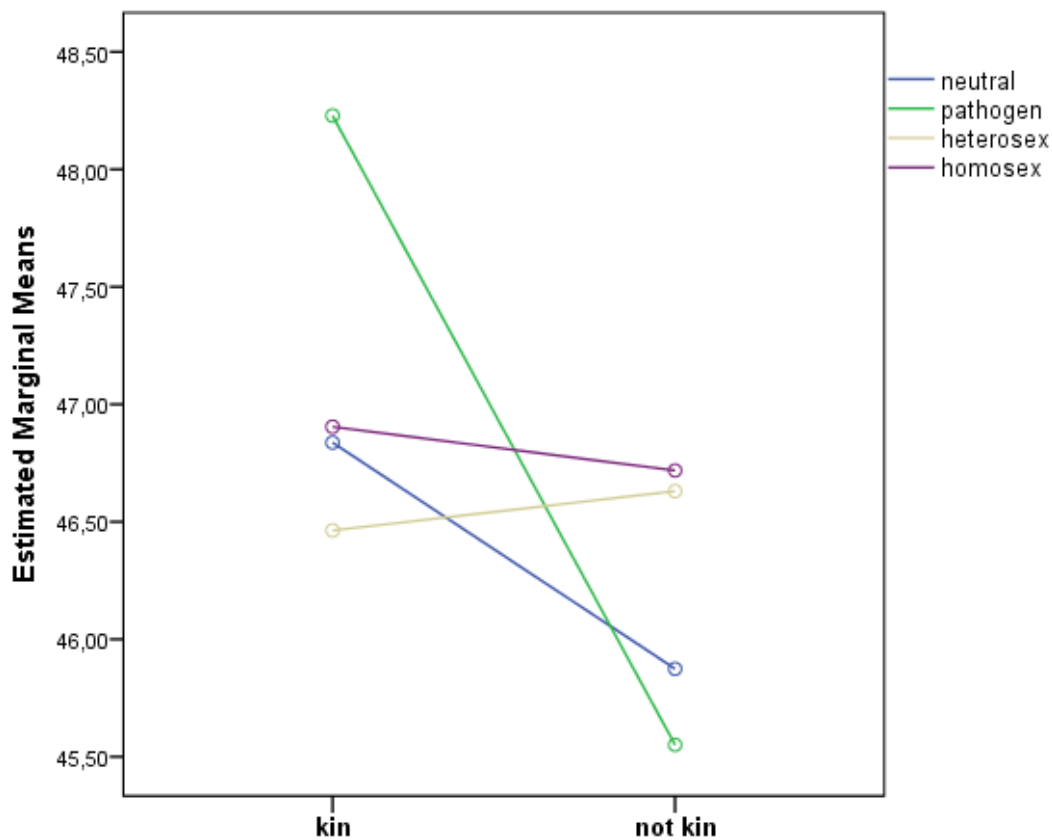


Figure 20 Mean self-report measures towards neutral, pathogen, heterosexual sex and homosexual sex images, displayed separately for each priming condition (i.e., kinship/not kinship)

4.4 Discussion

With this experiment we aimed to investigate the entrenchedness of sexually aversive responses to incest, by testing whether the subtle suggestion of incest is enough to trigger an aversion response. In an individual experimental set-up, subjects were semantically primed with concepts related to ‘family’, potentially followed by an image depicting a sexual activity. Two priming procedures were worked with, in a between-subjects design. In the first priming procedure (lexical decision task), stimuli were presented in two blocks. Each block presented either words referring to family or words not referring to family, but each time alternated with gibberish words. In this procedure, subjects decided as quickly as possible whether the word was real or not. In the second priming procedure (semantic categorization task), stimuli were presented in one block, alternating words referring to family and words not referring to family. In this procedure, subjects decided as quickly as possible whether the word referred to family or not. Thus, in the latter task, subjects’ attention was more explicitly drawn to ‘family’, since they were asked to actively go looking for this semantic information. Nonetheless, we observed that the task manipulation (lexical decision vs semantic categorization task) did not create overall differences in fEMG responses or self-reports, a couple of exceptions aside. As a consequence, data of both tasks were combined in all further analyses.

It was shown that pathogen disgust images elicited stronger fEMG disgust responses than any other category (i.e. images depicting neutral scenery, heterosexual sex and homosexual sex). Oddly enough, however, this was not accompanied by a lower self-reported enjoyment when watching the pathogen disgust images.

Images displaying homosexual activities elicited stronger fEMG disgust responses than images depicting heterosexual sex, indicating that gay sex induces an intuitive sexual disgust response. In a broad sense, this aligns with current investigations on the processes involved during attitude formation towards homosexuality. For instance, it has been shown that these attitudes are related to disgust sensitivity (e.g., Olatunji, 2008; Inbar et al., 2009), and vary when disgust is experimentally induced (e.g., Inbar et al., 2012; Cunningham et al., 2013). The difference we attested in fEMG responses was not accompanied by differences in self-reported enjoyment.

Curiously, fEMG responses to neutral stimuli did not differ from responses to heterosexual and homosexual sex stimuli. As indicated by Vrana (1993), muscle activity in the *levator labii* region is typically elevated when experiencing disgust, but may also be picked up during the experience of joy (see also Yartz and Hawk, 2002). This is due to so-called cross-talk, i.e. the electrode placement for levator labii might also slightly register zygomatic activity (facial muscles active when smiling). Indeed, during the pilot study, our neutral images generally elicited higher degrees of valence compared to the

images of other categories (see appendix 3). Nonetheless, they did not evoke higher self-reported enjoyment during the experiment itself.

In the critical tests, we mainly found that heterosexual images did not lead to increased fEMG measured facial disgust or decreased enjoyment when preceded by prime words referring to family. On the contrary, fEMG responses to heterosexual sex after family words were on average *lower* than responses after primes not referring to family. We hypothesize that this odd finding might potentially have to do with the attested difference in valence between the family and the non-family words (see appendix 2). In the pre-test, family words were on average evaluated as positive (MEAN±SD = 6.02±.96 on a scale from 1 (very negative) to 7 (very positive)), while words not referring to family were on average evaluated as neutral (MEAN±SD = 4.05±.1.04). Thus, it is likely that the family words induced a positive mood, which subsequently interfered with the experience (or, to be correct, the facial expression) of disgust. If this interpretation of the data is correct, it also means that the lack of a significant effect in the expected direction is not due to a flawed priming procedure. Subjects were indeed semantically primed with ‘family’, but it simply did not bring about the expected effect.

We conclude that, although the human sexual aversion for incest is undoubtedly deeply psychologically embedded, a conscious consideration or explicit imagination of the act might still be essential for an aversive response to be evoked. Nonetheless, we are fully aware that the experiment described in this chapter only provides one possible way for testing this hypothesis. In this case, absence of evidence hardly equals evidence of absence. Future studies could for instance test for differential outcomes when using a priming procedure that indeed makes use of photographs of subjects’ own family members, a possibility that we briefly described in the introduction section. As a benefit, such a design could potentially more strongly trigger the hypothesized signalling function of the disgust facial expression.

Summary and conclusion

In chapter 1 it was argued that evolutionary psychology provides an interesting theoretical framework for explaining the evolved origins of our sexual aversion for siblings. The accumulated evidence provides a convincing argument that these sexual aversions can be predicted by psychological mechanisms for kin detection. Two cues have been identified for the detection of siblings based on contextual informational input: maternal perinatal association and coresidence duration. Also, there is evidence that suggests the use of phenotypic cues, such as facial resemblance and smell. By the end of the first chapter, we hypothesized that the measurement of physiological responses can potentially be an interesting complementary method for the study of incest aversion, to be used in addition to self-reports.

In chapters 2 and 3, we tested this hypothesis in subject samples drawn from Belgian student populations, and this for females and males separately. Results indicated that when females imagine having sex with a brother, electromyographic activity in the *levator labii* region of the face, which is typically elevated when expressing disgust, can be predicted by duration of childhood coresidence in case of absence of maternal perinatal association with that brother. For females reporting the presence of maternal perinatal association, electromyographic activity was predicted by the frequency of experiences highly indicative for shared parental investment during mutual childhood. In males, no significant association could be observed between childhood coresidence duration and electromyographic activity in the *levator labii* region, regardless of presence or absence of maternal perinatal association. The direct relevance of these empirical findings has been discussed extensively in the closing sections of both chapter 2 and 3. Here, we wish to give some additional consideration to two topics that drew our particular attention. First we will formulate some reflections related to the method itself, which may be of interest to those who wish to further explore the embodied emotional response of disgust in response to incest. The second topic includes reflections on the relative impact of evolved psychological mechanisms and of cultural/environmental/educational influences on our sexual aversion for incest.

The empirical findings derived from chapters 2 and 3 indicate that facial disgust expressions made in response to personal incest scenarios are useful for uncovering the relevant predictors of sexually aversive responses to incest. Clearly, our data displayed substantial inter-individual variability in facially expressive disgust responses (see chapter 3, figures 12, 13 and 14). The absence of ceiling effects contrasts with its regular presence in self-report measures. Nonetheless, as we already indicated briefly in the first chapter, physiological measures might also be subject of conscious control, through emotional suppression (i.e., the conscious inhibition of ongoing emotion expressive behaviour) or through cognitive reappraisal (i.e., the reinterpretation of an event so as to change its emotional impact) (for a brief overview, see Reynaud et al., 2012). Such strategies have been shown to be effective for the suppression of overt, visible expressions of disgust, including but not limited to facial expressions (Gross, 1998). Undoubtedly, the imagination of sibling incest caused a certain degree of discomfort in our subjects, especially since the experimental set-up also included sexually explicit visual materials. Potentially, this caused our subjects to apply cognitive reappraisal strategies, for which we see some evidence in our data. For instance, we consistently observed lower fEMG responses during the second interval time window (4-8 s) after image display, compared to the first interval (0-4 s). Additionally, the most interesting patterns in relation to the hypothesized predictors (i.e., kin detection cues) were most often found when analyzing first interval responses.

Given the fact that any method has its benefits and constraints, self-reports of subjective feelings and facial disgust expressions should preferentially be used alongside each other. This would also enable a further exploration of the relation between physiological and affective components of the disgust experience, the need of which we already discussed at the end of chapter 3. However, and importantly, recent research indicated that being instructed to self-report on subjective feelings, versus not being given this instruction, alters physiological reactions, in particular cardiac responses, in situations that evoke anger (however, not in situations that evoke shame) (Kassam & Mendes, 2013). Thus, the characteristic physiological components of some emotions, at least anger, may alter when people are asked to shift their attention to cognitive awareness of the subjective experience. If a change in facial expressions is also observed when merely experiencing versus also reporting on disgust, an alternative strategy could be to investigate how facially expressive responses and affective feelings (measured at separate occasions) relate to broader behavioural strategies, for instance the bodily and verbal signalling of sexual disinterest. Obviously, such research should not exclusively focus on incest, but rather include a broad range of topics in the sexual domain.

The measurement of facially expressed disgust could be of particular interest to investigate incest aversion for parent-child dyads. Currently, there is few research that has investigated the relation between kin detection cues for parents or children and

experienced sexual aversion. A notable exception is a recent investigation of Antfolk et al. (2014). These authors collected self-report disgust towards personal scenarios (e.g., ‘you and your mother having sex’) and third party scenarios (e.g., ‘someone and their mother having sex’). However, data derived from the personal scenarios displayed such strong ceiling effects that they could not be analyzed. Moreover, data derived from the third party scenarios needed to be rescaled from an original Likert-type scale (1= not at all disgusting to 9 = extremely disgusting) into a dichotomized scale (1= original responses 1 to 8; and 2= original response 9). Again, this was due to low variance in responses due to ceiling effects.¹ After doing so it was found that, in males, received maternal support during childhood predicted self-reported disgust towards incest between a mother and a son (Antfolk et al., 2014). No statistically significant patterns were found in the data of females. Thus, as facial disgust expressions are less subjective to ceiling effects than self-reports (at least when it comes to sibling incest aversion), it is recommended to use this method to test the relevant predictors of sexual aversions towards parents and towards children.

Secondly, our attention is particularly drawn to how the aversion for incest may be relatively determined by kin detection cues and cultural proscriptions about the inappropriateness of such behavior. Although Westermarck (1891) suggested that sexual disinterest for close family members emerges spontaneously, our data might indicate that parental attitudes towards sexuality may additionally contribute to a man’s aversion for having sex with his sister. Specifically, we attested that, in males, parental sexual conservativeness was associated with stronger facial disgust in response to imagined sex with a sister. It has been hypothesized earlier that evolved psychological mechanisms for the inhibition of sexual interest towards close family members are less effective in males (a hypothesis that aligns with parental investment theory), and that, as a consequence, men may additionally ‘benefit’ from cultural proscriptions. Haig (1999, p. 94) for instance argued that “the possibility that males sometimes have incestuous inclinations that run counter to the interests of other members of society is a plausible explanation for the institution of incest taboos. The associated punishments and social disapprobation increase the opportunity costs for potentially incestuous

¹ More in general, it has been found that consensual sex between parents and children is judged to be more morally wrong than consensual sex between siblings. Lieberman et al. (2007) for instance reported that, in a comparative rank-ordering task, consensual sex between a mother and a son or a father and a daughter was rank-ordered as more morally wrong than consensual sex between siblings. Also, Antfolk et al. (2012a) found that self-reported disgust towards sex between parents and children (not involving the appraiser him- or herself) is larger than self-reported disgust towards sex between siblings.

males and provide a powerful disincentive to incest.”² However, Haig (1999) does not explain against which *interests of other members of society* incest would be running. Nonetheless, several suggestions can be derived from the literature. It may for instance run against inclusive fitness interests. Antfolk et al. (2012b) for instance found that incest between individuals that are genetically related to the appraiser elicits stronger self-reported disgust than incest between individuals not genetically related to the appraiser. Additionally or alternatively, the incest taboo may be related to the interests of societal leaders who want to avoid wealth accumulation due to marriages between close kin (Thornhill, 1991), a hypothesis which we discussed in section 1.2.3.

We have limited evidence suggesting that the incest taboo instruction is a pedagogical component: a fairly high number of subjects (33% of men and 49% of women) reported remembering being instructed during childhood that sexual contact between close family members is inappropriate. However, these responses may have been driven in part by socially desirable responding, and were not associated with facial disgust responses to incest. Perhaps more remarkable is the fact that subjects (both males and females) with an opposite-sex sibling did not display stronger fEMG responses to the incest scenario than subjects without opposite-sex siblings. This again subscribes the influence of cultural proscriptions.

In the second part of this dissertation, we will leave the path of investigating how kin detection cues are related to sexual disinterest in close family members. Instead, we will now take a closer look at the implementation of the incest taboo in current society. In particular, we will focus on the continued existence of laws that aim to discourage consensual sexual behaviour between adult close kin, and on individual moral attitudes regarding such behavior.

² This matter also recalls an argument of Frazer (1910), stating that the universal occurrence of the incest taboo does not make sense if there is already an innate aversion for sexual relations with close kin (see section 1.1).

Part II. The legal future of consensual sex between adult siblings

Introduction and overview

For the past 50 years, and in western industrialized societies, human sexual behavior has been morally re-shaped as an act of individual, autonomous persons, with consent as its cardinal rule (Frank, Camp & Boutcher 2010). As a consequence, paternalistic policies that set down acceptable and non-acceptable sexual preferences and partner choices are slowly fading (e.g. laws that sanction homosexual sex). Nonetheless, this increased open-mindedness about sexuality is bounded, as certain sexual acts, even when involving consenting adults, are still commonly met with public abhorrence. One such act is consensual sex between closely related adults (e.g. parent-child pairs, sibling pairs). Legal provisions that intend to discourage relationships between adult close relatives are left unchanged in nations worldwide, mirroring the public sentiment.

Legal cases that involve consensual relationships between close relatives are actually fairly uncommon. A recent case receiving substantial media attention was Patrick Stübing, a German citizen who was convicted multiple times (in 2002, 2004 and 2005) for having sexual relations with an adult sister he never grew up with. In 2012, Stübing took his case to the European Court on Human Rights (ECHR), asserting that section 173 of the German Criminal Code (i.e. the law that penalizes adult consensual incest) violates Article 8 of the European Convention on Human Rights. This article intends to guarantee and protect European citizens' autonomy and privacy, including respect for family life, lifestyle, and sexual preferences. In that same year, the Court unanimously decided that no such violation takes place in case of criminal provisions regarding incestuous sex between adults (Stübing vs. Germany, ECHR 43547/08). Apart from referring to the widespread social taboo on incest, it was argued that these legal provisions fulfill a pressing social need by protecting the family unit from falling apart and by impeding the detrimental outcomes of inbreeding.

A first issue that will be addressed in this part, is the argumentative soundness of today's rationales for the restriction of partner choice when it comes to family relatedness (chapter 5). We were also interested in the current positions of legal scholars regarding the desirability to either reform such laws, or to leave them unchanged. An equally important question is to what extent the justifications for upholding such legal restrictions (and, by extent, their argumentative qualities) are relevant for people's opinions. As will be discussed in chapter 6, empirical research

gives us reason to believe that moral attitudes regarding consensual incest are to a large extent intuitively and emotionally driven. In chapter 7 we present a study that further explores the hypothesis that moral attitudes about incest are strongly influenced by one's personal sexual aversion for incest. Finally, in chapter 8, we empirically assess the assertion that people find consensual incest so appalling that any rationally sound plea for a more tolerant view on the subject would serve nothing but a lost cause (Boyer & Petersen, 2011). We shall explore the potential malleability of attitudes towards consensual adult incest, assuming that not only intuitive but also cognitive processes influence these decisions.

In sum, this second part of the dissertation aims to bring together contemporary legal positions on consensual sexual relationships between adult family members, and moral psychological research on incest aversion. Essentially, the central question we try to answer is this: what is the moral psychological feasibility of law reformation, given that the issue is at the center of a clash between the principles of freedom of partner choice and mutual consent in sexual relationships on the one hand, and strong intuitive moral opposition against such behavior on the other hand.

Chapter 5 Justifications of legal restrictions on consensual sex and relationships between adult close family members

“The question of incest prohibition [...] coincides with questions about where the moral authority of society begins and, concurrently, what is the rightful limit to the sovereignty of the individual over his or her own moral choices.” (Leeming, 1996, p. 314)

5.1 Introduction

In general, distinction is being made between two kinds of laws that constrain consensual sex and relationships between adult close kin. Civil laws mainly consist of marriage impediments and are omnipresent. Criminal laws, on the other hand, sanction sexual contact between family members and are less widespread. For example, all member states of the European Council have civil laws on consensual sex between adult relatives, while only half of them have criminal laws (see *Stübing v Germany*, ECHR 43547/08). In Western Europe, German (§173, (2) StGB), Swiss (art. 213, 1 StGB) and Austrian (§ 211, (3) StGB) legislations are examples that include criminal sanctions against consensual sex between adult siblings.¹ In the last decades, some European governments have critically examined their legal take on consensual relationships

¹ For an extensive comparative overview of national legal provisions across the globe regarding consensual sex between adult close kin, see Albrecht & Sieber (2007). Of the 20 countries that were reviewed in this report, 13 criminally sanction consensual relationships between adult family members (i.e., Australia, Chile, Denmark, England, Greece, Italy, Canada, Poland, Romania, Sweden, Switzerland and nearly all states in the US – no criminal sanctions in Ivory Coast, France, the Netherlands, Spain and Turkey).

between adult close kin. Below, we briefly discuss three examples: Scotland (1980), the United Kingdom (2000) and Germany (2007, 2014).

Leeming (1996) discussed the Scottish Law Commission's report (1980, 1981) regarding the reformation of incest legislation. Figure 21 (from Leeming, 1996) summarizes the legislative units that contributed to the eventual creation of the Incest and Related Offences Act in 1986. While the pre-1567 view on incest was that of an ecclesiastical offence, in 1567, both a Marriage Act and an Incest Act were created, respectively dealing with forbidden marriages between relatives (related by consanguinity or affinity) and with forbidden sexual contact between relatives. From then on, and covering a timespan of more than 400 years, only a few minor changes were made. Most interesting to us are the Commission's arguments in favor of the criminalization of consensual sex amongst adult close kin. In the actual text, the arguments are captured under the following headings (Scottish Law Commission, 1981: Para. 3•9, cited by Leeming, 1996):

- The protection of members of the family, especially children, from psychological harm, molestation and injury.
- The maintenance of the solidarity of the family and the strengthening of its fabric.
- The recognition of the repugnance felt by significant numbers of the community and their strong opposition to the idea of sexual intercourse between certain closely related persons.
- The reduction of the risk of the birth of children with defects of a genetic origin.

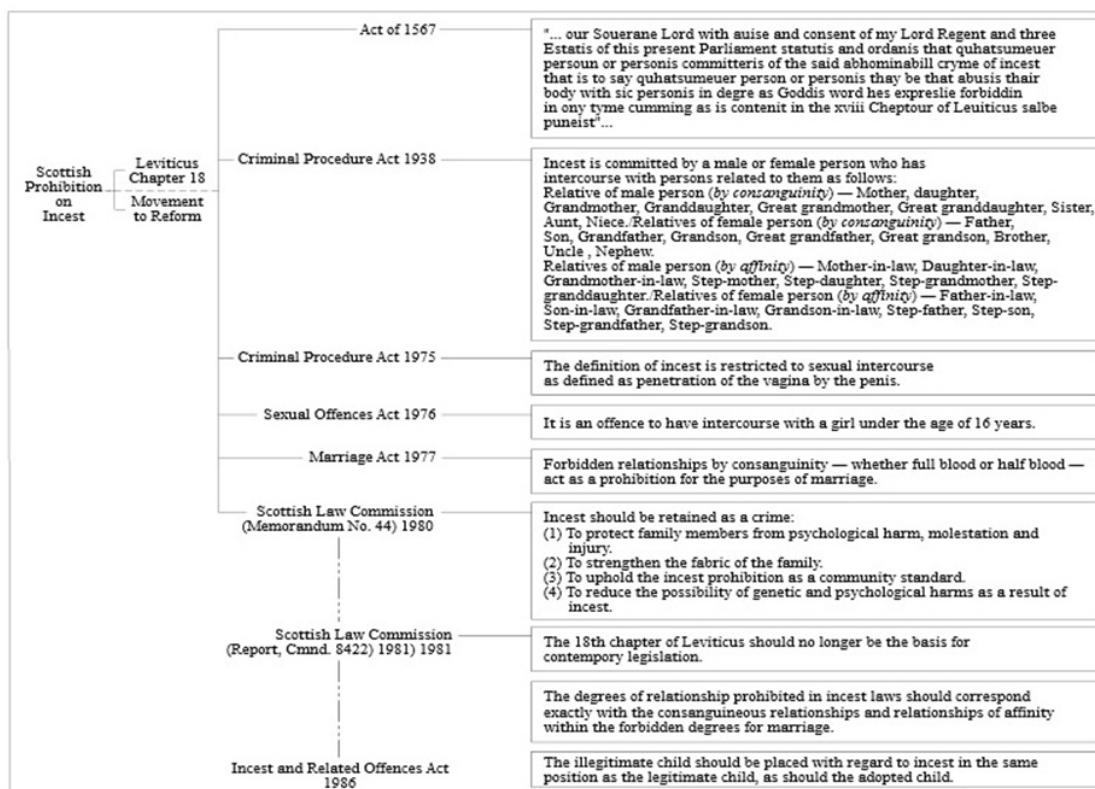


Figure 21 Changes to the Law of Incest in Scotland, 1567–1986 (Leeming, 1996, p. 321).

Recently, Roffee (2014) analyzed the way consensual incest between adults was discussed in a British governmental report on sexual offences, evocatively titled *Setting the boundaries* (Home Office, 2000). In this report, it was advised to maintain the ban on sexual penetration² between close family members (related by blood or adoption). Rationales mentioned are

- protecting children and the more vulnerable people in the family (Home Office, 2000, 5.5.3)
- protecting the family unit (Home Office, 2000, 5.8.3)
- upholding basic moral standards (Home Office, 5.8.1), including the recognition that incest evokes widespread repugnance (Home Office, 5.1.4).

Roffee (2014) strongly criticizes the rhetorical strategies used throughout the report, such as the assumption that all incestuous relationships are somehow abusive and the use of the morally non-neutral term ‘incest’ when discussing consensual relationships.

² Similar to the definition of incest in the Scottish law (Criminal Procedure Act, 1975), incest is defined in England and Wales as penile-vaginal penetration (Sexual Offences act, 1956).

In 2007, a team of the Max Planck Institute for Foreign and International Criminal Law, published an extensive analysis of the criminal prosecution of consensual relationships between closely related individuals (Albrecht & Sieber, 2007). The report commences with a historical analysis of the emergence of sanctions against this behaviour on German territory. At the start of the 21st century, the criminal liability of consented sexual behaviour between adult close relatives is still in effect, despite the voice of legal scholars in Western Germany who had argued for its abolishment since the second half of the previous century (Albrecht & Sieber, 2007, p. 13). The relevant law, §173 StGB, currently includes sexual intercourse between biological full and halfsiblings and biological relatives in ascending/descending lines, and is punished with a fine or imprisonment up to 2 years (siblings and descendants) or 3 years (ascendants).³ Today, the total incidence of convictions in Germany approximates less than 10 per year. In september 2014, a report was published by the German Ethics Council pleading for the abolishment of the criminal liability of voluntary sexual relationships between adult relatives (Deutscher Ethikrat, 2014). The abolishment of §173 StGB, so it was argued, would not threaten the continued existence of a strong social taboo⁴, while at the same time the sexual rights of minorities would be respected.

In this chapter, building further on the preceding work of legal scholars, we assess the arguments for imposing legal constraints on consensual relationships between adult close kin, as illustrated by the examples above.

³ §173 StGB specifies that siblings and descendants are not prosecutable before reaching the age of 18. The article deals with ‘incest as such’, not involving cases of sexual abuse or minors, which is dealt with in §§ 174 - 184 and 184g StGB (see for instance § 174 Abs. 1 Nr. 3 StGB). Sexual intercourse between ascending and descending relatives by marriage ceased to be criminalized in 1973.

⁴ The German Ethics Council discusses the strong social taboo regarding incest by making reference to for instance empirical research in moral psychology (e.g., Haidt et al., 2000, also discussed in chapter 6 below). Throughout the report, the social taboo is considered as a given. It is not discussed whether it would be desirable or feasible to change our moral judgments when it comes to specific cases such as consensual sex between siblings who did not grow up together.

5.2 Harm-related arguments

5.2.1 Harm to the family unit

Laws prohibiting consensual adult incest are said to serve the protection of the (nuclear) family unit, by delineating each member's role and place. However, this argument turns out to be in conflict with the content of most incest laws. For instance, Parker (1987) and Bratt (2004) pointed out that, if familial stability would be the underlying rationale, these laws should apply to genetic as well as stepfamily as they share the same family unit. However, laws on consensual adult incest most often include merely genetic relatives. Only 22 states in the U.S. (or 44%) include stepparents and – children in laws on consensual adult incest, while none of the 26 members of the European Council that have criminal provisions on consensual adult incest explicitly include stepfamily. A second way in which incest laws conflict with this argument is that criminal provisions mostly prohibit 'sexual intercourse', but not sexual behavior at large.⁵ Nonetheless, any kind of sexual behavior between family members could bring along role confusion within the family. Thirdly, these laws often include relatives who are not part of the same family unit, such as uncles, aunts and cousins. This makes them unnecessarily over-inclusive (Bratt, 2004).

Last but not least, it is silently assumed that the incidence of sexual relationships between members of the same family unit will increase in the absence of laws against consensual adult incest. In other words, that such provisions function to steer people away from this behaviour. However, there are sound theoretical and empirical arguments indicating that most people spontaneously develop a sexual aversion towards, e.g., the people they have grown up with (see part 1). In other words, in the absence of laws against consensual adult incest, we should not expect families to start falling apart.

5.2.2 Harm to vulnerable family members

A second reason to uphold legal provisions on consensual adult incest sets off from the assumption that such unions consist of a dominant and a subordinate partner. Family structures are known to create dependency, and therefore the more vulnerable family members (i.e. younger and female) can become involved in a so-called consensual

⁵ Some countries however do include broader acts of penetration, including anal and oral seks (e.g., Denmark and Poland) (Albrecht & Sieber, 2007).

incestuous relationship, while in fact they are unable to stand up to the stronger partner. As a consequence, these weaker family members would need to be protected. From a scientific point of view however, these assertions are nothing more than mere speculation. It remains to be investigated empirically how often consensual adult incest takes place, and how such relationships develop. Moreover, Cahill (2000) argued that under criminal provisions, it would be difficult to determine who dominates whom. While presumably, a daughter would be thought of as the weaker partner in an adult father-daughter relationship, determining dominancy is much more difficult in an adult mother-son or sibling relationship. Also, McDonnell (2004) and Roffee (2014) pointed out that cases of dependency of one sexual partner on the other could fall within the range of criminal provisions protecting sexual autonomy in general.

5.2.3 Genetic harm

The argument on genetics comes in two variants. The first focuses on the harm large-scale inbreeding could inflict on society as a whole, and is steeped in controversy because of a connotation of eugenics (Henn et al., 2008). The second variant centers on the harm inflicted on the actual offspring of incestuous unions. They indeed have an increased theoretical risk of suffering from genetic diseases, disabilities and premature death and that risk becomes larger when the parents have more genes in common (e.g. Bittles, 2004, p. 52). Empirical data that confirm these theoretical risks are scarce however and inconclusive, mainly because of methodological difficulties (i.e. finding adequate test and control groups; see Bittles, 2004, pp. 49-54).

According to McDonnell (2004) and Farrelly (2008) the critical question here is whether being born with an increased risk of genetic defects is worse than not being born at all. But more important perhaps, is that most laws on consensual adult incest forbid marriage and sex, but not having children per se. So, one can make a case for civil laws being under-inclusive, because close family members can still have children outside of wedlock. On the other hand, it makes criminal laws also clearly over-inclusive, as sexual contact does not necessarily imply procreation (Anonymous 2006). Moreover, it has been argued that, if this increased risk of genetically-burdened offspring is a valid reason, the same standard should be applied to all people with a known increased risk of passing on a genetic disease (Anonymous 2006; Farrelly 2008; Bratt 2004). As such, Cahn (2009) and Bratt (2004) proposed that a more desirable alternative would be to encourage consensual incestuous couples with a child wish to rely on genetic counseling and medically assisted reproduction.

5.2.4 Harm to the well-being of children

In some countries, the criminal provision on incest includes both consensual incest between adults and child sexual abuse, while other countries have separate statutes for dealing specifically with incest involving minors. Protecting children against intrafamilial sexual abuse is unquestionably a legitimate aspiration. From a different perspective, offspring stemming from incestuous parents may very likely experience a social stigma, because of the nature of their parents' relationship. However, it would be a circular argument to use this as a reason to uphold laws against consensual adult incest, as these laws themselves subscribe the persistence of social stigmatizing.

5.3 The morality argument

The argument on morality has a factual and a normative component. The factual component refers to the observation that public morality seems to be heavily turned against consensual sex between adult kin. The normative component of this argument entails that public morality should be reflected in and protected by the law. In this section, both components will be discussed in turn.

5.3.1 The factual component

The incest taboo has a long tradition in cultural history. Some anthropologists even speculated that the incest prohibition was among the first rules in human history and a starting point of cultural life (Lévi Strauss, 1969; Fox, 1967, see also part 1, section 1.1). It is a truism that the meaning of 'incest' shows great historical and cross-cultural variance, and that it is not always limited to sexual behavior between genetic kin. It seems to depend on the cultural definition of kinship (El Guindi & al Othman 2013) but also on a bendable concept of 'closeness', whereby sexual contact between people who are 'too close' should be avoided (see also Westermarck, 1917, as discussed in section 1.1 of part 1). Not only genetics or family units create such closeness, but also for example being born from the same surrogate mother (for adults in the UK, Edwards, 2004); or having been breastfed by the same woman (for Malaysian mothers, Carsten, 1997; in Qatari culture, El Guindi & al Othman, 2013). Also, neither marriage nor sexual contact are prerequisites for incest. During interviews, British subjects deemed the acts of a man donating sperm to his daughter and a woman giving ova to her son, as incestuous behavior (Edwards, 2004). Even when its meaning is fixed on sexual behavior between

family members, cultures tend to display large variance as to what forms are accepted, not accepted, and even privileged. For instance, cultural perceptions regarding cousin marriage greatly differ between Europe and several North-African and Middle Eastern countries (see, e.g., Bittles, 2004).⁶ The taboo on incest varies so greatly through time and place, that it is questionable to discuss ‘the’ incest taboo or to use ‘its’ universality in the context of defending laws against consensual sex between adult kin. Nonetheless, research in moral psychology has shown that legal constraints on voluntary sexual relations between close family members is indeed backed up by moral disapproval of such behaviour.⁷ By assessing attitudes through interviews (e.g., Haidt et al., 2000) or anonymous surveys (e.g., Royzman et al., 2008), it is very often judged to be morally wrong. For instance, 79% of subjects indicated it to be morally wrong in the study of Royzman et al. (2008). In the chapter that follows we will discuss the moral psychology of incest aversion more elaborately.

5.3.2 The normative component

The normative part of this argument entails that public morality should be reflected in and protected by the law. Certainly, it is a good thing that domestic laws are embedded in public morality so that they become broadly accepted and respected. The inverse relation remains more controversial. Acts can be considered immoral by many people, but are nonetheless legal, such as pornography (Hayes & Carpenter, 2012). However, as discussed in the previous section, when it comes to voluntary sexual relations between adult close kin, individual moral attitudes are very often negative. Moreover, the experience of negative emotions (typically, but not limited to, disgust) add motivational strength to these beliefs. It may be tempting to include these common feelings of aversion as an argument for defending the moral wrongness of the act. There is a lot of disagreement, however, on whether so-called ‘gut’ feelings, including disgust, should be accorded any moral or legal value.

Sceptics have argued that, if moral beliefs are mostly based on emotional responses, then we would do well not to let our legal decisions be based on them (see Nussbaum, 2004). Disgust, it was argued by Nussbaum (2004), is irrational in the normative sense,

⁶ Interestingly it has been hypothesized that consanguineous marriages may arise adaptively in response to local environments which are high in pathogen prevalence, in order to maintain local adaptations that foster protection against local pathogens (see Hoben et al., 2010).

⁷ These empirical studies have almost exclusively investigated moral attitudes regarding voluntary sexual behavior between adult *siblings* and have mainly focused on subject samples from student populations of *western industrialized* countries.

since the use of it as an argument in moral decision making has led to gross evils throughout history. According to Nussbaum (2004), this is because disgust in the moral domain is typically associated with the human desire to differentiate themselves from animals and mortality (derived from terror management theory, see section 6.2.1 below), which is in practice often acted out against vulnerable people and groups. Although disgust may be very useful in the domain of protecting us against eating for instance contaminated food, it should be banned from the legal atmosphere. Also Kelly (2011, p. 140) argued that the emotion of disgust “deserves no privileged status in ethical thought and should be regarded with deep suspicion in the moral domain”. Kelly (2011) hypothesized that disgust’s primarily evolved function is to protect us against toxins and diseases, and was later on co-opted⁸ in the moral domain. Although it is very useful to study disgust in function of a better understanding of the presence of certain societal norms and components of moral behaviour, we should be extremely cautious to apply disgust to the ethical domain, still according to Kelly (2011).

Others have argued that emotions, disgust in particular, may be informative for moral decision making. Nussbaum (2004) identifies Lord Devlin’s pro-disgust argument, made during a lecture in 1959 called ‘The enforcement of morals’, as the most influential. He argued, as cited by Nussbaum (2004), that loosening societies moral bonds is often the first sign of society’s disintegration. Therefore, society needs to put constraints on certain personal freedoms. The reliable basis for lawmaking, as argued by Devlin, is the standard of the ‘reasonable man’. What should be maintained and protected as the basic moral standard in society are those behaviors that the reasonable man finds very intensely intolerable, indignating, or disgusting. In 1997, Leon Kass defended the use of disgust in the context of morality and law in a newspaper article, tellingly entitled ‘the wisdom of repugnance’. It was argued that feelings of revulsion, specifically applied to the topic of human cloning, are not ethically suspect, even not when such feelings cannot be rationally justified. The experience of strong aversion can function as an ethical guidance, by telling us which moral principles and opinions we – rightfully – do not wish to break. By doing so, it can act as a defender of “the central core of our humanity” (Kass, 1997, p. 20). An additional, more recent argument was built up by Plakias (2013). It was argued that, just as pathogen disgust warns us for contamination in the physical environment, the experience of disgust in the moral domain may warn us for, what she called, social contamination. Essentially, feeling disgust in a moral context is justified when the act is intrinsically immoral, and

⁸ Essentially, Kelly (2011, pp. 6-7) argues that the disgust system was conjoined “with a norm psychology that evolved to help coordinate social interactions and produce behaviors that are locally adaptive, given the specific demands of different niches and circumstances”.

whether its occurrence can induce copying behaviour in others (i.e., the social contamination argument).

On a different note, from the perspective of current sexual morals in western industrialized societies, laws against consensual sex between adult kin seem to be somewhat outdated. Legitimate sex is no longer limited to contraceptive-free vaginal intercourse within the boundaries of marriage. Alternative sexual behaviors and partner choice are no longer perceived as threatening to the social order, or deemed morally deviant and unnatural. The prohibition on adult consensual incest seems to be a remainder of an outdated standard in sexual morality. Therefore we believe that the argument on public morality can both be used to defend and to criticize laws on consensual sex between adult kin.

5.4 The future of laws on consensual adult incest

In the previous sections we summarized and discussed the arguments that aim to justify legal provisions regarding consensual adult incest. As we found out, all of them are debatable. Restraining consensual adult incest undoubtedly limits freedom of partner choice and sexual life, while potential harms could be avoided by other criminal laws (e.g. those protecting sexual self-determination) or by less intrusive recommendations (e.g. genetic counseling of incestuous couples with a child-wish).

However, there appears to be few public and political interest to abolish such laws (Albrecht & Sieber, 2007, pp. 47-48).⁹ Obviously, one of the main reasons is that incidences of consensual relationships between adult close family members seem to be rare.¹⁰ It is hard to imagine that civil rights movements would start advocating for the right of close family members to have consensual relationships with each other. Moreover, the validity and relevance of laws on consensual adult incest have not been the subject of extensive debate in legal studies either. Authors who did contemplate about the subject, have either defended the status-quo as long as social norms do not change, or have carefully pleaded for the reformation or abolishment of such laws.

⁹ On the other hand, in countries that lack criminal sanctions there is also no polemic about putting these back into practice (Albrecht & Sieber, 2007, p. 48).

¹⁰ We can only assume that these are rare, since representative data regarding the prevalence of such relationships are lacking (Albrecht & Sieber, 2007, p. 89).

McDonnell (2004) for instance, argued that the general moral disapproval of consensual adult incest constitutes the appropriate moral justification for the corresponding laws. As long as the moral norm itself remains nearly unquestioned, laws regarding consensual adult incest between close genetic relatives are not expected to change, still according to McDonnell (2004). Nonetheless, he did not exclude that over time norms and the corresponding laws on consensual adult incest between cousins might be overturned.

Cahill (2005) on the other hand pleaded to put our intuitive aversion against such unions aside in favor of a more rational approach to the subject. She stresses that 'incest' is first and foremost a powerful metaphor in our minds, which would explain why it is used in slippery slope arguments to refer to a state that we do not want to reach.

According to Collins et al. (2008, p. 1391), "in situations where genuine and mature consent between the parties is possible, and where negative externalities can be eliminated, the criminal law should prescind from application", negative externalities being genetic difficulties, sexual jealousies within the family, and coercion. These authors argued that in some cases those negative externalities may no longer apply, for instance in the case of consensual sex between adopted siblings with different birth parents. In situations like this, it would be better for the state not to sanction this behavior, but instead to express its concern through civil law or civil education, according to the authors. They further suggested to detach incest laws from their biological content and to focus on the presence of asymmetrical dependency (e.g. any adult that figures as a parent vs. a child that depends on his/her care). the authors seem to disagree however whether consensual relationships should be prohibited between adults who were once, when younger, involved in such a relationship of asymmetrical dependency.

The general lack of current societal and legal interest into the subject does not necessarily imply that consensual adult incest will remain a non-issue from a social and legal perspective. In fact, and for several reasons, we might expect in the near future an increasing societal and legal interest into the subject of consensual sex between adult family members. First, it has been suggested that the frequency of the phenomenon could increase in the following years, due to the variety in family arrangements which increasingly lead to a limited availability of kin detection cues (such as limited duration of co-habitation in divorced families, see below) (Lieberman & Smith 2012). Secondly, it has been reported that genetic relatives sometimes experience a strong mutual sexual attraction, when being reunited after a long period of separation or when meeting for the first time as adults. This has been dubbed 'genetic sexual attraction' or 'post-adoption incest' (see e.g. Silverman & Bevc 2005). Currently, only media reports and support groups witness of its existence, as there is no systematic research regarding its prevalence (Albrecht & Sieber, 2007, p. 92; Deutsche Ethikrat, 2014, p. 24-25).

Nonetheless, if this phenomenon is real, we might expect it to increase, in unison with the rise in adoptions and gamete donations (presuming that donor identification allows such a reunion). Thirdly, Cahn (2005) pointed out that as a result of the increase of gamete donation, so-called ‘accidental’ incest might become a concern, especially in countries where the amount of donations is unlimited (for example the U.S.). This means that sexual partners might be unknowingly related after being conceived with the gametes of the same individual. In the field of bioethics, the topic has received attention in the context of medically assisted reproduction when a woman wished to be impregnated by donor eggs fertilized with the spermatozoa of her own brother (Pennings 2002). Fourthly, the legal and normative discussion on the feasibility of abolishing laws on adult consensual incest has intrinsic academic value, by exploring the boundaries of a novel sexual morality governed by the principle of mutual consent and challenges the scope and limits of this guiding principle.

5.5 Concluding remarks

In a nutshell, two positions in the current legal debate can be identified: a status-quo position that argues to maintain the existing prohibitive civil and/or criminal legislation, and an adjustment position that defends a modification of these laws on rational grounds. Both acknowledge that legal restrictions on sexual relationships between adult family members are partly based on a widespread consensus that sex between relatives is repulsive. However, the positions are deviating with regard to the justifiability of this emotional argument. It is an ethical matter, and one that is much harder to debate than the harm-related arguments we mentioned before. There is however also a moral psychological question component to this issue, in terms of the mere practical feasibility of the adjustment position.

Finding widespread democratic support for the modification of laws concerning voluntary sexual relationships between adult close kin depends on the willingness of people in general (not only of the experts in the field) to adjust their moral viewpoints. This in turn depends on people’s capacity to do so. As we briefly discussed in section 5.3.1, research in moral psychology indicated that consensual sex between adult close relatives is generally morally opposed. As we discussed in part 1 (chapter 1, section 1.2.3), it is plausible that moral attitudes on incest are a byproduct of self-regulation. When making moral judgments, it is hypothesized, we imagine how it would feel if being involved in such behaviour ourselves, which elicits very strong feelings of aversion. Thus, following this hypothesis, the moral condemnation of incest might be psychologically very profound. As a consequence, it may be practically almost

implausible – as irrationally as it may be – for people to give much consideration to rational arguments that lend priority to the principle of mutual consent for those cases that concern consensual and harmless behaviour. A related, and more basic, question is how the moral condemnation of consensual incest between adults exactly looks like. For instance, besides strong feelings of aversion, how motivated do people feel to actually punish such behaviour? In order to address these questions – i.e., the structure of the moral condemnation of consensual incest and the feasibility of adjusting these attitudes – we will take a closer look at moral psychological investigations in the next chapter.

Chapter 6 Moral attitudes about consensual sex between adult kin

6.1 The structure of moral decision making about incest

6.1.1 Intuitive processes

Interview-based research revealed that consensual adult sibling incest is very often classified as being morally wrong, even when fictional cases describe the use of two methods of contraception and no psychological harm being inflicted on the siblings or their families (Haidt et al., 1993; Haidt et al., 2000). In another study, large proportions of participants stated that sexual behaviour between adult siblings should be illegal, that it is universally morally wrong and would remain so even if an authority would make it permissible (Turiel et al., 1991). That a taboo-breaking, yet harmless act evokes this kind of pattern in moral judgment is challenging to the cognitive-developmental theory on moral decision making (see, e.g., Piaget, 1965; Kohlberg, 1969; Turiel, 1983). In short, this theory states that moral issues are cross-culturally limited to issues involving harm, rights, or justice. They are supposedly intrinsically interpersonal issues, and actions are judged by a rational consideration of their material and psychological consequences.

Yet, moral opposition against consensual sex between adult siblings hardly resembles being the result of deliberate rational processes. When interviewees are being asked to substantiate their moral disapproval, they either make unsupported declarations ('it is just wrong'), they are morally dumbfounded (they refer to the harms it might cause, and are unable to explain the wrongness of harmless forms of consensual sex between adult siblings), or they simply admit not to know why (Haidt et al., 2000). This fits well within the moral psychological theory of social intuitionism (Haidt, 2001). According to this theory, everyday moral judgments are the result of quick, automatic evaluations, rather than of deliberate reasoning. Trying to justify their intuitive responses, people

deliberately search for post-hoc arguments, which could explain why they are ‘morally dumbfounded’ when being pointed at the weakness of their arguments.

This social intuitionist account is backed up by the empirical observation that moral judgments regarding voluntary sexual relations between adult relatives are accompanied by strong emotional responses. Typically, these take the form of disgust (e.g., Fessler & Navarrete, 2004). Even nausea, gagging and diminished appetite are reported to be felt when thinking of such acts (Royzman et al., 2008). Also, when being hypnotically induced to experience disgust, people make harsher moral judgments regarding sexual behavior amongst first cousins, suggesting that disgust feeds into moral judgments on incest rather than being the consequence of it (Weatley & Haidt 2005).

Consensual sex between relatives are not only accompanied by disgust, but also, and presumably to a lower extent, anger. Gutierrez and Giner-Sorolla (2007) for instance described that participants reported feeling both angry and disgusted while reading three fictional cases of taboo-breaking behaviors, one of which was consensual sexual between adult relatives. However, self-reported disgust was higher than self-reported anger. It is possible that consensual incest between adult siblings typically evokes anger in people who presume that any kind of ‘incest’ will bring about harm (Gutierrez & Giner-Sorolla, 2007). Following Gutierrez’ and Sorolla’s (2007) hypothesis, post-hoc explanations referring to harm are given to justify the anger that is intuitively felt when thinking about (presumed, ‘harmful’) consensual sex between adult siblings. Also Piazza et al. (2013) observed self-reported anger towards sexual acts between relatives, but again to a lower extent than self-reported disgust.

A small side note to the negative emotional valence that seems to be accompanying the consideration of sexual behaviour between adult kin, is that incest can also be the topic of fascination, at least in the context of fictional or artistic expressions. To name just one example, the suggestion of an incestuous mother-son relationship was a main theme in Robert Bloch’s *Psycho*. In other words, there might be some degree of emotional ambivalence. Such ambivalence can be witnessed towards many tabooed behaviors. It has not been investigated whether such positive emotional arousal (e.g. interest or curiosity for the theme of incest in artistic expressions) is in any way relevant for moral decision making about real-life cases.

6.1.2 Cognitive processes

The social intuitionist account suggests that explicit moral attitudes regarding incest are mainly intuitive and emotionally-driven. What follows is that, rational considerations are, first and foremost, post-hoc rationalizations of intuitive judgments. However, recent research pointed out that deliberate considerations might affect moral

attitudes towards incest to a greater extent than suggested by the intuitive/emotional model for moral decision making.

A first relevant empirical finding was that people respond differently to consensual sex between family members depending on several characteristics of the family bond. Questionnaires administered to Finnish college students showed that incest between genetic relatives, co-raised family members, or parents and children elicited more disgust than incest between non-genetic relatives, family members that grew up apart, or siblings (Antfolk et al., 2012a). There is clearly a remarkable analogy between the relevant distinctions made by Finnish subjects and some rationales for laws on consensual sex between adult relatives described in the previous chapter. That is, according to Finnish subjects, consensual sex between adult relatives is more disgusting in the presence of co-residency (see section 5.2.1), a hierarchical relation (see section 5.2.2), or a genetic bond (see section 5.2.3).

Intentionality as well has been shown to be a relevant predictor of moral judgments about consensual sex between adult siblings. For instance, Young and Saxe (2011) found that participants judged intentional sex between adult relatives to be more morally wrong than when it happens accidentally, while both acts were considered to be equally disgusting. Also, moral judgments about failed attempts of intentionally committing incest depend on the reason for this failure. The authors compared moral judgments between the following two types of failed attempt: (1) the sexual act took place but was not incest because the person was falsely believed to be a sibling, (2) the person was indeed related but the sexual act did not take place because of an interruption. It was shown that (2) was judged to be more morally wrong than (1). So, when intentionality is present, additional moral weight seems to be given to how close the actors come to actually committing incest (case 1 could never have been incest, while case 2 almost happened and would have been incest).

Another relevant empirical discovery was that the presence or absence of harm may be a better predictor of moral judgments than disgust. Royzman et al. (2009) measured moral opinions regarding consensual sex between adult relatives, by asking whether it is still wrong: (1) in the absence of a social norm, (2) when it takes place in a country where it is generally accepted, (3) in this country when it is generally accepted in another country. It was found that the answers to these questions differed depending on the perceived harmfulness of the act (physical, psychological, or otherwise). However, no association was found between moral opinions and participants' general disgust sensitivity.

Nonetheless, other researchers keep emphasizing the relevance of emotional experience for self-reported attitudes towards incest, as well as willingness to consider mitigating circumstances. Recently, Piazza et al. (2013) included 'siblings passionately kissing on the mouth' as a moral transgression when investigating differences in considering mitigating circumstances between harm and purity-related acts. Subjects

were asked to indicate how morally wrong it is for two siblings to kiss each other passionately on the mouth, and to write down the circumstances that would make the act permissible. Self-reported disgust and anger towards the act were positively associated with moral wrongness of the act, but disgust was the only significant independent predictor. General disgust sensitivity was unrelated to the number of mitigating circumstances that were given. Self-reported anger towards the act, but not experienced disgust, significantly predicted the number of mitigating circumstances that were given. However, also the tendency to being a deontologist (as opposed to being a consequentialist) in moral decision making predicted the number of mitigating circumstances as well.

Recently, Royzman et al. (2014b) attested that proneness to cognitive rational thinking is associated with lower moral rejection of incest. To measure differences in deliberative capacity, the authors used a cognitive reflection test (Frederick, 2005), which includes solving three mathematical puzzles aimed to gauge individual ability and/or willingness to spend more time and effort in cognitively loaded tasks. Moral attitudes were assessed about two adult siblings kissing each other.

In sum, the current empirical data regarding moral decision making about incest may be best aligned with the hypothesis that moral decision making is a multi-system process, driven by both ratio and affect, albeit possibly to different degrees (e.g., Cushman et al., 2010).

6.2 Explanatory models

The question arises why exactly disgust is typically associated with the moral rejection of incest. In this section, we will describe two different viewpoints that aim to explain this link. Both positions seem to agree that disgust evolved from being initially a purely ‘oral’ emotion to increasingly becoming also a ‘moral’ emotion (Rozin et al., 1999a; Tybur et al., 2009). However, when it comes to moral decisions about incest, they disagree about whether the disgust experienced is fed by cognitive programs that make us experience disgust to protect ourselves against suboptimal reproduction (i.e., the empathic disgust response hypothesis), or whether it is a consequence of cultural proscriptions (i.e., the cultural psychological hypothesis). We explain each of both positions in further detail below.

6.2.1 The cultural psychological hypothesis

According to Rozin et al. (2008), disgust's original evolutionary function was the protection of the human body from pollution and contamination, and was later adopted by culture to protect the human soul from harm (e.g. through interpersonal contact and moral offenses). The underlying rationale is that humans want to create and maintain boundaries between themselves and animals, a position that heavily relies on terror management theory (see, e.g., Greenberg et al., 1997). Therefore, aspects that remind us of our animal nature (e.g. poor hygiene, death, sex) are most of all prone to feelings of disgust. According to this cultural psychological theory on moral psychology (e.g. Shweder et al., 1997; for empirical validation see Rozin et al., 1999b), a separate code of moral thought and discourse, called 'the ethics of divinity', was culturally invoked in function of the animal-human boundary maintenance and to attain purity of the spirit. Such norms are supposed to include a wide range of topics, such as which foods are appropriate to eat, proper dealing with members of other social groups but also typically topics related to the sexual domain. Cultures, as well as individuals, rely on this ethics of divinity to different degrees. For example, political conservatives are hypothesized to rely more on the ethics of divinity than liberals (Haidt & Hersh, 2001).

When it comes to the moral rejection of voluntary sexual relations between close relatives, however, political liberals and conservatives have been shown not to differ (Haidt & Hersh, 2001). A recent study of Royzman et al. (2014b) however indicated that political liberalists were less opposed against consensual kissing between adult siblings. Also, empirical research showed no differences in attitudes between adolescents with a catholic background and adolescents without a religious background (Turiel et al., 1991). These outcomes tend to suggest that moral opposition against consensual incest is not evidently associated with correlates that typically point at being moral psychologically prone to the ethics of divinity.

Recently, Royzman et al. (2014a) reported that a majority of participants (61%) considered the mere act of shaking hands with people who commit consensual sibling incest to be in violation with the ethics code of divinity which was described to participants as follows:

"Divinity/purity violations. In these cases a person disrespects the sacredness of God, or causes impurity or degradation to himself/herself, or to others. To decide if an action is wrong, you think about things like sin, the natural order of things, sanctity, and the protection of the soul or the world from degradation and spiritual defilement." (Rozin et al., 1999b, pp. 575-576)

Forty-three percent of participants associated the shaking of hands with feelings of nausea, gagging or diminished appetite, and an almost equal amount (45%) associated this with the desire to move away. However, only 12% associated this with an urge to

retaliate. Most importantly, these results suggest that social avoidance tendencies may dominate the urge to punish during moral decision making about consensual incest between adults.

Royzman et al. (2008) developed what they called the moral dyspepsia hypothesis, which asserts that the disgust response experienced when making decisions about incest is a direct result of the moral judgement itself (see also part 1, section 1.2.3). The moral wrongness of consensual incest is hypothesized to be instigated by cultural proscriptions only, not by personal sexual aversions. As the reader will notice below, this is essentially what the empathic disgust response hypothesis disagrees with.

6.2.2 The empathic disgust response hypothesis

Evolutionary psychologists assert that humans spontaneously lack the motivation to engage in sexual behaviors with their closest kin, e.g. siblings (see part 1, section 1.2.1). These personal sexual aversions have been put in relation to moral opposition against consensual sex between close family members (Lieberman et al., 2003, see also part 1, section 1.2.2.2). In a nutshell, the disgust evoked by consensual incest posed by others is presumed to be the result of an empathic response. During moral decision making about incest in others, we make a personal re-interpretation of the situation: we mentally picture ourselves being engaged in such behaviour, which automatically evokes a disgust response.

The strongest argument in favour of this hypothesis is that it explains why the exposure to cues for sibling detection seem to not only predict our personal sexual aversions but also our moral decisions (e.g., Lieberman, 2003; but see Royzman et al., 2008 for contrary evidence). Importantly, this account is not necessarily in disagreement with the observation of a large cross-cultural variance in the definition of 'incest', and related prohibitions. However, based on this account, one would expect less cross-cultural variance in individual attitudes when it comes to sexual contact and relationships between close relatives, such as parents and their children or siblings (Fessler & Navarrete, 2004). This might indeed be the case (see, e.g., Parker, 1976). Also, this explanatory model can account for the attested gender differences in moral opposition against consensual sex between adult relatives. Women sometimes self-report to be more morally opposed against such behavior than men (see, e.g., Fessler & Navarrete 2004; Royzman et al., 2009, but see Royzman et al., 2008 and Royzman et al., 2014b, for a lack in gender differences), which parallels the observation that women are more disgust-sensitive than men (Haidt et al., 1994), but especially when it comes to disgust that is related to the sexual domain (Tybur et al., 2011). Evolutionary psychology relates such gender differences to differential reproductive costs (parental investment theory, Trivers, 1972, see also above, section 1.2.1).

Figure 22 displays a schematic overview of the processes involved when making moral decisions about consensual incest amongst adults for which we have empirical evidence. Also, it includes predictions about inter-individual variability in such judgments.

Figure 22 Schematic overview of empirical findings on moral decision making about consensual sex between adult siblings, and predictors of inter-individual variability

<p>MORAL DECISION MAKING ABOUT CONSENSUAL SEX BETWEEN ADULT SIBLINGS</p>	<p>INTUITIVE/EMOTIONAL PROCESSES</p> <ul style="list-style-type: none"> ▪ Intuitive, fast decision; ‘moral dumbfounding’ (Haidt & Bjorklund, 2000; Haidt, 2001) ▪ Associated with the experience of disgust (Lieberman et al., 2003; Fessler & Navarrete, 2004; Gutierrez & Giner-Sorolla, 2007; Piazza et al., 2013) ▪ Associated with the experience of anger (Gutierrez & Giner-Sorolla, 2007; Piazza et al., 2013) ▪ Emotional experiences (anger) are related to cognitive presumptions about the act (Gutierrez & Giner-Sorolla, 2007) ▪ Anger and disgust are negatively associated with the consideration of mitigating circumstances (Piazza et al., 2013) <p>COGNITIVE PROCESSES</p> <ul style="list-style-type: none"> ▪ harmfulness of the act (Royzman et al., 2009) ▪ intentionality of the actors (Young & Saxe, 2011)
<p>PREDICTORS OF INTER-INDIVIDUAL VARIABILITY</p>	<ul style="list-style-type: none"> ▪ childhood exposure to cues for sibling detection (see, e.g., Lieberman et al., 2003; Fessler & Navarrete, 2004; but not attested in Royzman et al., 2008) ▪ gender: stronger rejection in women than in men (mixed evidence: e.g., confirmed in Fessler & Navarrete, 2004, and Royzman et al., 2009, but not in Royzman et al., 2008, and Royzman et al., 2014b) ▪ cultural proscriptions (Fessler & Navarrete, 2004; Royzman et al., 2008) ▪ consequentialistic vs. deontological moral reasoning style (Piazza et al., 2013) ▪ proneness to rational thinking (Royzman et al., 2014b) ▪ political attitudes (liberalism/conservatism) (Royzman et al., 2014b; not in Haidt & Hersh, 2001)

6.3 Concluding remarks

In this chapter, we have taken a closer look at the typical processes involved when making moral decisions about consensual incestuous behavior in adults (summarized in figure 22). There is much evidence for the social intuitionist hypothesis, which states that these attitudes are mainly the result of a quick intuitive/emotional process. Nonetheless, recent research increasingly indicates the involvement of deliberate considerations. Importantly, the moral rejection of consensual incest is consistently associated with disgust, and, only to a much lower degree, with anger. There is also evidence that people might feel more motivated to shun people who are in a consensual relationship with a close sibling (e.g. unwillingness to shake their hands, unwillingness to live next door to them) rather than to retaliate against them. From this perspective, laws that punish consensual adult incest (with for instance fines or imprisonment) might not be in concordance with how the general folk morally responds to this type of behavior. People don't want consensual incest to happen, because they don't want to be socially confronted with individuals committing incest, not because they actually think such behavior should be (severely) punished. Indeed, as indicated by Fox (1962, p. 131), "the two factors of incest anxiety (horror) and prohibitions are again not necessarily related. One can be horrified by incest and not do anything about it: on the other hand one can forbid it without any particular affect being associated with the prohibition. Sanctions are one kind of index of feelings about incest, but not the only one, and not necessarily the most reliable."

If people do not prioritize punishing this behavior, finding democratic support to move away from a criminalization of consensual sex between adult kin (i.e., abolishing an explicit prohibition) may not be that difficult. Indeed, in countries that do not criminalize such behavior, there is no polemic about putting such laws into practice (Albrecht & Sieber, 2007, p. 48). According to the German Ethics Council, the issue (decriminalization or not) revolves around finding a balance between protecting the sexual freedom of a minority while respecting the moral sensitivities of the majority:

"Rechtlich verfasste Gesellschaften müssen im Rahmen ihrer Normenordnung einen Ausgleich zwischen entsprechenden Mehrheits- und Minderheitspositionen suchen und dabei dem Freiheitsschutz auch der wenigen gegenüber dem Gefühlsschutz sogar der großen Mehrheit das ihm moralisch wie rechtlich zustehende Gewicht beimessen." (Deutsche Ethikrat, 2014, p. 49)

The German Ethics Council argued that the abolishment of explicit prohibitions against consensual sex between adult relatives guarantees sexual freedom, while at the same time respecting the continued moral condemnation of this behavior by the large

majority of people (Deutsche Ethikrat, 2014). However, we tend to disagree with them about this point.

If we consider for a moment a situation in which there are no legal constraints (i.e., both in civil and criminal law) on consensual relationships between adult close kin. Indeed, such a situation would respect freedom of partner choice, but unless this legal change is accompanied by a change in moral viewpoints, the social stigma would continue to exist. As argued above, such stigmatizing is undesirable, above all because this might harm the well-being of children born from partners that are close kin (see section 5.2.4). Also, despite a lack of systematic research, there is anecdotal evidence that people involved in such relationships most often suffer from being considered a pariah (Deutsche Ethikrat, 2014). What they basically strive for is social acceptance of their relationship, not merely abolishing the laws that explicitly forbid such behavior. For this reason, we disagree with the German Ethics Council which assumed that the abolishment of laws on consented forms of incest between adults is, from an ethical point of view, reconcilable with the continued existence of a social taboo and, thus, moral rejection of this behavior.

Returning to moral psychology, the essential question is then: how feasible would it be to change the social perception on consensual sex between adult close kin? As we discussed both in this chapter (section 6.2.2) and in part 1 (chapter 1, section 1.2.3), it is plausible that moral attitudes on incest are a byproduct of self-regulation (i.e., the empathic disgust response hypothesis) (Lieberman et al., 2003; Fessler & Navarrete, 2004). When making moral judgments, according to this premise, we imagine how we would feel when being involved in such behaviour ourselves. This provides one possible explanation for why we typically feel aversion (disgust) when considering sexual behaviour between close kin. We argued in part 1 that this sexual aversion for incest is profoundly embedded in our psychology. Trying to alter this instinct would not only be unfeasible, it is also highly undesirable. In fact, it is highly desirable that spontaneous mechanisms for incest aversion are efficiently activated in members of the same family, in order to avoid the devastating consequences of transgressions of sexual autonomy within the family. If the empathic disgust response hypothesis holds true, then it might be much more difficult to change the social perception of consensual sex between adult close relatives. For this reason, in the next chapter, we shall further explore the validity of this hypothesis.

Chapter 7 How strongly is sibling incest morally opposed at the implicit level?

7.1 Introduction

As described in the previous chapter, mutually consented sibling incest is strongly morally opposed and elicits disgust during explicit attitude assessment (e.g., Haidt et al., 2000; Lieberman et al., 2003; Fessler & Navarrete, 2004). We highlighted two explanatory hypotheses for the psychology of moral decision making about incest. One was dubbed the empathic disgust response hypothesis, which states that during moral decision making, people imagine how it would feel to display such behaviour themselves. As a consequence, moral decisions reflect personal sexual aversions and should be predictable through kin detection mechanisms (proposed by Lieberman et al., 2003), as well as cultural proscriptions (proposed by Fessler & Navarrete, 2004). According to this hypothesis, subjectively felt personal sexual aversions feed into moral decision making about incest. The other hypothesis was dubbed the cultural psychological hypothesis, which alternatively states that moral decision making about incest does not involve a personal reinterpretation of the scenario, and should be predictable through cultural proscriptions but not through kin detection mechanisms. According to Royzman et al. (2008), the subjective experience of disgust is a consequence of moral decision making about incest rather than it feeds into the process.

Currently, there is limited evidence in support of both hypotheses. Aiming to contribute to the advancement of this issue, we developed an experiment that tested how strongly incest is associated with moral wrongness at the implicit level.¹ The

¹ As indicated by Greenwald and Banaji (1995), the terms implicit-explicit cover a range of overlapping distinctions such as unaware-aware, unconscious-conscious, intuitive-analytic, direct-indirect, procedural-declarative, and automatic-controlled.

method that is used (see below) includes a cognitively demanding speed task which allows no opportunity for subjects to start consciously imagining the act in a personally reinterpreted way. As a consequence, personal sexual aversions cannot develop, which, according to the empathic disgust hypothesis, greatly add to our moral rejection of incest. Thus, if the empathic disgust response hypothesis holds true, then we should find a relatively lower moral opposition against incest at the implicit, as opposed to the explicit, level. If the cultural psychological hypothesis holds true, according to which there is no personal reinterpretation and feelings of aversion are the consequence of moral decision making, then we should find an equally strong outspoken rejection of incest at the implicit level.

Another question of interest was whether it is possible to detect cultural differences in implicit attitudes regarding incest. As a start, subjects from two western industrialized countries were included, i.e. Belgium and the U.S. There is reason to believe that general attitudes towards marriage and relationships are more conservative in the U.S. than in Belgium. Recently, Treas et al. (2014) published a cross-national comparative analysis on attitudes regarding marriage and relationships, based on data collected in up to 21 countries. Across a wide range of topics related to modern-day relationships (including non-marital cohabitation, nonmarital childbearing and divorce), it was indeed consistently shown that attitudes in the U.S. were more conservative than in any other nation included in the study.² Also, laws concerning consensual sex between adult relatives are stricter in the U.S. than in Belgium. In the latter, only civil laws prohibit marriages between siblings, while nearly all the states of the U.S. include both civil laws prohibiting marriages and criminal laws sanctioning sexual behavior (Albrecht & Sieber, 2007). As explicit attitudes towards relationships in general, and presumably towards consensual relations between genetically related persons in specific, are more conservative in the U.S compared to Belgium, we are interested whether this cultural difference is also detectable at the level of implicit moral attitudes.

Also, we were interested in the potential presence of gender differences at the level of implicit moral attitudes. As discussed in previous chapters, when it comes to explicit attitudes, moral opposition against consensual incest between adult siblings is sometimes larger in women than in men (e.g., Fessler & Navarrete 2004; Royzman et al., 2009). For this reason, we also tested for the presence or absence of gender differences in implicit moral attitudes regarding incest.

² Belgium was not included in this research sample, but neighboring countries such as the Netherlands and Germany were.

Finally, attitudes in general are assumed to be strong predictors of real-life behavior (Greenwald and Banaji, 1995). As a consequence, real-life intentions to shun or punish people who have consensual sex with an adult relative – and, by extent, the acceptance of laws that delineate the authorized punishment of such behaviour – should be predictable through moral attitude assessment. However, as stressed by for instance Greenwald and Banaji (1995), real-life behavior should be associated with both the explicit and implicit dimension of attitudes.³ This also counts for moral behavior and attitudes (see e.g. Marquardt & Hoeger, 2009). As such, this experiment should provide us with a more full-scale picture of the moral rejection of incest.

In sum, we aimed to investigate whether the explicit moral opposition of incest is accompanied by opposition at the implicit level, and whether cultural differences as well as differences between men and women can be detected at this level. Below, we start with explaining the method that was used for the assessment of implicit attitudes.

7.2 The implicit association test

A widespread method for measuring cognitive or evaluative associations at the implicit level is the implicit association test (IAT) (Greenwald et al., 1998). It intends to assess automatic affects or attitudes that people may sometimes not even be aware of. Essentially, the IAT measure is a speed task, that includes sorting words that are presented on screen into their appropriate categories. These categories include two target concepts (e.g. ‘insect’ and ‘flower’) and two evaluative attributes (e.g. ‘pleasant’ and ‘unpleasant’).

A classic IAT procedure is composed of five stages. In the first stage, subjects are familiarized with the onscreen placement of the target category dimension. In this stage, words that are presented in the centre of the screen have to be categorized corresponding to their appropriate target that is placed on either the left or the right of the screen (e.g. assigning names of specific flowers to the ‘flower’ category that is placed on the left side of the screen vs. assigning names of specific insects to the ‘insect’ category that is placed on the right side of the screen). During the second stage, the

³ As indicated by Greenwald and Banaji (1995), the terms implicit-explicit cover a range of overlapping distinctions such as unaware-aware, unconscious-conscious, intuitive-analytic, direct-indirect, procedural-declarative, and automatic-controlled.

same procedure is repeated for the attribute dimension⁴ (i.e. assigning pleasant words to the ‘pleasant’ dimension’ that is placed on the left side of the screen and unpleasant words in the ‘unpleasant’ dimension that is placed on the right side of the screen). The third stage combines the first two stages, alternating the presentation of words referring to target or attribute dimensions. Each time, the word that needs to be sorted is presented in the middle of the screen, while one target dimension (‘flower’) and one attribute dimension (‘pleasant’) are presented on the left side, and the other target (‘insect’) and attribute (‘unpleasant’) on the right side. Sometimes, this stage is split up in a practice round, followed by an actual test round. In stage 4, the placement onscreen of the target dimensions is reversed (‘flower’ on the right, and ‘insect’ on the left), and again only includes words presented centrally on screen that refer to one of these target dimensions. In the fifth and last stage, target and attribute dimensions are again combined, retaining the reverse ordered presentation of target dimensions as in stage four. Again, sometimes, this stage is split up in a practice round and a test round.

The IAT aims to assesses automatic associations of target and attribute dimensions (e.g. ‘flower’ with ‘pleasant’ and ‘insect’ with ‘unpleasant’) by comparing the differences in time needed to sort the words into their appropriate categories (so-called ‘latencies’). The underlying principle of the IAT is that, if ‘flower’ is implicitly associated with ‘pleasant’ and ‘insect’ with ‘unpleasant’, then task performance should be easier (and thus, categorization should happen faster) when ‘flower & pleasant’ vs. ‘insect & unpleasant’ are presented on opposite sides of the screen, compared to when ‘flower & unpleasant’ vs. ‘insect & pleasant’ are presented on opposite sides of the screen.

As indicated by Web of Science’s citation counts, ever since the test was developed in 1998, its original publication (i.e., Greenwald et al., 1998) has been cited 2762 times (December 2014). Many of those citations are empirical papers, which have put this test into practice in a broad array of domains. Classically, the IAT was applied to measure implicit racial attitudes or ingroup/outgroup biases (as discussed for example by Dasgupta et al., 2003). Later, the use of the test was expanded to include a wide range of so-called sensitive topics. These are contexts in which people are prone to give socially desirable answers when asked about their explicit opinions. Such topics include attitudes towards disabled persons, gender stereotypes or attitudes towards homosexuals. Recent research has been focusing increasingly on strategies to change implicit discriminatory attitudes (e.g. Lai et al., 2014) and on the relation between implicit attitudes and real-life discriminatory behavior (see, e.g., Greenwald et al., 2009 and Blanton et al, 2009).

⁴ Alternatively, the procedure can also start with familiarization with the attribute dimensions, followed by familiarization with the target dimensions.

Following Greenwald et al. (1998), additional methodological papers have been focussing on the improvement and further development of the technique of implicit association testing. Within the context of our study, two specific methodological modifications are worth mentioning. A first involves the development of an enhanced algorithm for processing responses into one generalized score that indicates the presence and magnitude of a bias. For a detailed description of the improved scoring algorithm, we refer the reader to the original paper (Greenwald et al., 1998) and its follow-up (Greenwald et al., 2003). Improvements are for instance located at the level of only using data of test trials (Greenwald et al., 1998) versus also including data of practice trials (Greenwald et al., 2003), and the absence (Greenwald et al., 1998) or presence (Greenwald et al., 2003) of a systematic treatment of subjects with excessively slow responding or high error rates. It was shown that the reviewed algorithm outperforms the conventional algorithm, amongst others in terms of internal consistency, so, preferentially, the former should be used (Greenwald et al., 2003).

A second adjustment worth mentioning is the development of a so-called single-category IAT (shortly, SC-IAT) (Karpinski & Steinman, 2006). As explained above, in its standard version, the IAT makes use of two target concepts (e.g. flowers and insects) and two attributes (e.g. pleasant and unpleasant). In other words, a target category of interest is always contrasted with a counter category. The choice of counter category may be a natural complement (such as men versus women) but may also be highly subjective (e.g. in case of opposing flowers with insects). When choice of counter category is subjective, however, it would be much more interesting to have the possibility of assessing the absolute evaluation of a specific category. The SC-IAT aims to provide an answer to this shortcoming of the classic IAT, since it includes only one target category but retains the two attribute categories.⁵ The SC-IAT displays a reliability that is similar to the reliability obtained by the classic IAT measure, but shows lower levels of internal consistency (Karpinski & Steinman, 2006). Its procedure includes two stages. In the first stage, words referring to the target category (e.g. 'self') and to one of the attribute categories (e.g. 'good') are categorized on one response key on the keyboard and the other attribute category (e.g. 'bad') on a different key. In the second stage, words referring to moral rightness are categorized using the same initial key, while the target category, here 'self', has switched positions, and has to be categorized using the same key as the words referring to moral wrongness. Each stage initiates with a practice round, including 24 trials, followed by a test round, including 72 trials. Figure

⁵ Before the single-category IAT (SC-IAT) was developed, Wigboldus et al. (2004) came up with the single-target IAT (ST-IAT) to address the same limitations of the classic IAT. Both measures share much more similarities than dissimilarities and can be used as equivalent alternatives (see e.g. Bluemke & Frieze, 2008).

23 depicts the procedural structures of a classic IAT and an SC-IAT. Further details regarding the SC-IAT procedure are provided in the ‘methods’ section below.

IAT					SC-IAT				
Block	Trials	Function	Left-key response	Right-key response	Block	Trials	Function	Left-key response	Right-key response
1	30	Practice	Pleasant words	Unpleasant words					
2	30	Practice	Self words	Other words					
3 _a	30	Practice	Pleasant words + self words	Unpleasant words + other words	1 _c	24	Practice	Good words + self words	Bad words
4 _a	30	Test	Pleasant words + self words	Unpleasant words + other words	2 _c	72	Test	Good words + self words	Bad words
5	30	Practice	Other words	Self words					
6 _b	30	Practice	Pleasant words + other words	Unpleasant words + self words	3 _d	24	Practice	Good words	Bad words + self words
7 _b	30	Test	Pleasant words + other words	Unpleasant words + self words	4 _d	72	Test	Good words	Bad words + self words

Note. Blocks with a common subscript were experienced as one continuous block.

Figure 23 Comparison of the procedural structure of a classic Implicit Association Test (IAT) and a Single-Category Implicit Association test (SC-IAT)

7.3 Methods

7.3.1 Participants

Twenty-two subjects participated during data collection in the U.S.. All subjects were students at the University of Miami (FL, U.S.A.) (age $MEAN \pm SD = 23.09 \pm 4.67$, 100% females). After participating, they received a financial compensation of 10 USD. Another 42 subjects were recruited at Ghent University (Belgium) (age $MEAN \pm SD = 19.83 \pm 2.82$, 45% females). These subjects received a financial compensation of 8€ after participating. The total sample size ($N=64$) was sufficiently large to allow detection of medium effect sizes (Cohen’s d of .50) in one-tailed one sample t -tests, at $\alpha=.05$ with power ($1 - \beta$) equal to .95 (see ‘statistical analyses’ below).⁶

⁶ In this case a minimum sample size of $N = 45$ is required (calculated using the software program G*Power, Faul et al., 2007).

7.3.2 Materials

7.3.2.1 The incest IAT

The experiment was conducted on a personal computer, using Inquisit 4.0 software produced by Millisecond Software. As explained in the introductory section, the SC-IAT consisted of two stages, each containing a practice round of 24 trials and a test round of 72 trials. In each round, participants were asked to sort a series of words, presented centrally on screen, into their appropriate categories, presented either on the left or the right side of the screen, as fast and as accurately as possible. In one stage – from now on termed ‘the compatible stage’ – ‘morally wrong’ and ‘sibling incest’ are presented at the left side of the screen, and ‘morally right’ at the right side. In the other stage – ‘the incompatible stage’ – ‘morally wrong’ was presented at the left side, while ‘sibling incest’ and ‘morally right’ were presented at the right. During the compatible stage, trials including words referring to ‘morally wrong’, ‘sibling incest’ and ‘morally right’ were presented at a 7:7:10 ratio. Throughout the incompatible stage, these trials were presented at a 10:7:7 ratio. Half of the subjects performed the task in the compatible stage – incompatible stage sequence, the other half of the subjects performed the task in the reverse order. The response latency was measured for each trial to be used as the dependent variable. If the subject gave an error response, a red cross appeared in the center of the screen, after which the subject had to correct their previous decision.

We strived to use stimuli that contained no more than 9 letters and no hyphens. We also strived for words in each category not to differ much in word length in order to minimize subjects classifying words based on word length (as pointed out by e.g. Nosek et al., 2007, p. 270). Appendix 4 includes an overview of the words used for the task. Importantly, the IAT target stimuli included verbs describing sexual acts. At the beginning of the task, it was made clear to subjects that these sexual acts should be interpreted as taking place between a brother and a sister. They were reminded of this prior to each experimental block (see also ‘procedure’ below). However, the IAT method requires that target words should be as equal as possible, conceptually, to the target concept (e.g. different names of flowers for the target concept ‘flower’). Obviously, verbs describing sexual acts are far from equivalent to ‘sibling incest’. The alternative, however, would have been to repeat the word ‘sibling’ both in the target concept (presented on the left or right of the screen) and all specific target words (presented in the center of the screen). Unfortunately, this would have enabled subjects to classify the words simply based on visual overlap (repetition of the word ‘sibling’). Nevertheless, we acknowledge that the lack of complete conceptual overlap between target words and target category is a limitation inherent to our study. We will return to this issue in the discussion section.

7.3.2.2 Questionnaire

A brief questionnaire was administered in order to gather demographical information (age and gender) as well as explicit attitudes regarding consensual incest. Two measures for explicit attitudes were used. As a first, subjects were presented with a scenario describing one-time consensual sex between a full brother and sister (derived from Haidt et al., 2000). Consequently, they were asked how morally wrong this behavior was, on a scale ranging from -5 ('very morally wrong') to +5 ('morally okay, not wrong at all') with a 0 point indicating 'neutral, not morally wrong or right'. Secondly, subjects were asked how disgusting this scenario was, on a scale ranging from -5 ('very disgusting') to +5 ('not disgusting at all') with a 0 point indicating 'neutral'.

7.3.3 Procedure

Each participant was tested individually. On arrival, the subject was randomly assigned to one of the two experimental conditions (congruent-incongruent order 67%), after which the experimental procedure was briefly explained to him/her by the researcher. Once being provided with a written informed consent, the researcher left for an adjacent room leaving the subject to complete the IAT task individually on a personal computer.

Participants were asked to categorize a series of words into their appropriate categories as fast and as accurately as possible. It was explained to them that the words would appear in the center of the screen, one at a time, while the categories would be constantly present in the upper left and upper right of the screen. Each word had to be sorted into its category, either by pressing the 'E' key of the keyboard using their left index finger (if the word belonged into a category in the upper left of the screen) or the 'I' key of the keyboard using their right index finger (if the word belonged into a category in the upper right of the screen). Subjects were asked to keep their index fingers on these keys throughout the duration of the task. They were told that, if the word was sorted incorrectly, an 'X' would appear on the screen, after which a correction had to be made, again as quickly as possible.

At the beginning of the task, subjects were given an overview of the categories (i.e. 'morally right', 'morally wrong' and 'sibling incest') and the corresponding words (for an overview, see appendix 4). The instructions stated explicitly that the words describing intimate or sexual acts referred to sibling incest, and were clarified using specific examples, e.g. 'kissing refers to kissing a sibling' (emphasis as on subjects' instruction page). Subjects were told that the task consisted of four blocks: two practice rounds, each followed by one test round. Subjects were not told, however, that the position of the categories (upper left vs. upper right corner) would switch during the task. Before each round, subjects were reminded to remain focused, and do the sorting

as quickly and as accurately as possible. They were also reminded of the categories, their corresponding words, and the fact that the words describing intimate or sexual acts referred to acts between siblings. The task took approximately 10 minutes to complete, after which the researcher returned and the subject completed the questionnaire using paper and pencil (Miami) or a personal computer (Ghent). This took about another 5 minutes.

7.3.4 Data preparation

The results of the IAT test were transferred from Inquisit to SPSS. Based on the responses to the IAT test, one D-score was calculated for each subject, following the improved scoring algorithm of Greenwald et al. (2003). Individual trials with latencies over 10000 ms were rejected from the data sample. Subsequently, the algorithm required to delete all data of subjects with response latencies of 300 ms or less in more than 10% of the trials. No such subjects were present in our sample. For each block (i.e. practice congruent, test congruent, practice incongruent, test incongruent), an average score and standard deviation were calculated based on correct responses. Also, one pooled standard deviation was calculated for all the practice trials and another one was calculated for all the test trials. The latencies of error decisions were replaced by the block mean (calculated above, based on correct responses) added by 2 block standard deviations (calculated above, based on correct responses). After this, new mean values were calculated for each block. Two differences scores were calculated: the first by subtracting the mean value of the congruent practice scores from the mean value of the incongruent practice scores and the second by subtracting the mean value of the congruent test scores from the mean value of the incongruent test scores. Subsequently, each differences score was divided by its associated pooled standard deviation, which was calculated before error replacement (see above). Finally, the two quotients from the previous step were averaged into what was called a D-score by Greenwald et al. (2003).

A positive D-score indicates faster responding in the congruent task (incest/morally wrong) vs the incongruent task (incest/morally right). Consequently, a positive D-score can be interpreted as an implicit bias for incest to be morally wrong. For subjects with larger positive D-scores, this bias is larger.

As explained by Greenwald et al. (2003), this D-measure closely resembles the effect size measure d (Cohen, 1977) which was used in the initial paradigm developed by Greenwald et al. (1998). The difference is that, in calculating Cohen's d , the pooled within-treatment standard deviation was used (i.e. one for the congruent trials and one for the incongruent trials), while for Greenwald's D , the standard deviation is computed from the pooled scores between treatments (i.e. one for the practice scores and one for the test scores).

7.3.5 Reliability and validity

Following the recommendations of Greenwald et al. (2003), internal consistency (split-half reliability) was verified by examining the correlation between the differences score of the practice blocks (i.e. practice incongruent minus practice congruent) and the differences score of the test blocks (i.e. test incongruent minus test congruent). For the total sample this estimate equalled .34; the estimate being higher in the US sample ($r = .44$) than in the Belgian sample ($r = .22$). This score is relatively low, compared to reliability estimates reported in other studies, e.g. in Greenwald et al. (2003) where they varied between .52 and .76.

In IAT research, construct validity is usually checked by correlating the results of the IAT with participants' explicit self-reported attitudes. In our sample, explicit attitudes about sibling incest were only assessed in female subjects ($N = 41$). As described above, subjects read a brief scenario about two adult siblings (a brother and sister) having onetime consensual sex. Subjects were asked how morally wrong and how disgusting this act was. As often with self-report measures on consensual incest, distributions for both scales were strongly right-skewed (morally wrong: $MEAN \pm SD = -3.34 \pm 2.32$; disgusting: $MEAN \pm SD = -3.90 \pm 1.93$). Results showed no significant correlation between the D-value and self-report measures but effect sizes ventured into the predicted directions (D and morally wrong: $r = -.09$, $p = .575$, $N = 41$; D and disgusting: $r = -.22$, $p = .163$, $N = 41$).

7.3.6 Exploratory analyses

We tested for differences in D-scores between the samples taken from Belgium and the United States. An independent samples t-test indicated a significantly larger D-score in subjects from the United States ($MEAN \pm SD = .46 \pm .36$) than in subjects from Belgium ($MEAN \pm SD = .23 \pm .43$) ($t(62) = -2.14$, $p = .036$). Therefore, Belgian and U.S. data were analyzed separately. In the Belgian sample, we did not observe order effects ($t(40) = .27$, $p = .789$), meaning that D-scores did not differ between the congruent-incongruent task order and the incongruent-congruent task order. As such, data of both task orders were jointly analyzed. However, in the U.S. sample, an order effect was present ($t(20) = -2.87$, $p = .009$): the incongruent-congruent order led to a larger D-score ($MEAN \pm SD = .65 \pm .24$) than the congruent-incongruent order ($MEAN \pm SD = .27 \pm .37$). As a result, for the U.S. sample, data of both task orders needed to be analyzed separately.

7.3.7 Statistical analyses

Critical tests were performed to check whether subjects indeed showed an implicit bias in associating ‘incest’ with ‘morally wrong’ rather than ‘incest’ with ‘morally right’. For each group, a one-sample t-test was calculated to check whether D-scores significantly differed from ‘0’ (which would mean an absence of bias). One-tailed significance results had to be taken into account, the direction of the expected effects being that D-scores would be significantly larger than 0 (i.e. that ‘incest’ is associated with ‘morally wrong’). Results on t-tests, as well as effect sizes (Cohen’s *d*) and achieved power ($1 - \beta$) at a significance level of .05 (one-tailed test), will be reported.⁷ Following standard conventions developed by Cohen (1988), cut-offs for small, medium and large effect sizes are respectively .2, .5 and .8.

Subsequently, an independent samples t-test was performed to check whether responses differed between men and women. If so, effect size (Cohen’s *d*) and achieved power ($1 - \beta$) will again be reported.

7.4 Results

7.4.1 Do subjects display an implicit bias for incest/morally wrong?

U.S. Sample – incongruent/congruent order (N=11)

Yes. A one-sample t-test showed that the average D-score in the U.S. sample with incongruent-congruent presentation order (MEAN \pm SD = .65 \pm .24) was significantly larger than 0 ($t(10) = 8.97$, one-tailed $p = .000$, $d = 2.71$, power = .90). In the incongruent-congruent presentation order, U.S. subjects implicitly associate incest with morally wrong.

U.S. Sample – congruent/incongruent order (N=11)

Yes. A one-sample t-test showed that the average D-score in the U.S. sample with congruent-incongruent presentation order (MEAN \pm SD = .27 \pm .37) was significantly larger than 0 ($t(10) = 2.40$, one-tailed $p = .019$, $d = .73$, power = .78). In the congruent-incongruent presentation order, U.S. subjects implicitly associated incest with morally wrong as well.

⁷ Based on the SPSS output, effect sizes and achieved power were subsequently calculated using the software program G*Power (Faul et al., 2007).

Belgian Sample (N=42)

Yes. A one-sample t-test showed that the average D-score in the Belgian sample ($\text{MEAN} \pm \text{SD} = .23 \pm .43$) was significantly larger than 0 ($t(41) = 3.44$, one-tailed $p < .001$, $d = .53$, power = .96), which indicates that Belgian subjects as well implicitly associated incest with morally wrong.

7.4.2 Do males and females differ in implicit bias for incest/morally wrong?

Since the U.S. sample only contained females, this test could only be performed on Belgian data. An independent samples t-test showed no differences in D-value between Belgian males ($\text{MEAN} \pm \text{SD} = .28 \pm .46$, $N = 23$) and Belgian females ($\text{MEAN} \pm \text{SD} = .16 \pm .39$, $N = 19$) ($t(40) = -.90$, $p = .373$).

7.5 Discussion

In this study we tried to gauge the implicit evaluation of sibling incest, by testing its association strength with ‘moral wrongness’ vs. ‘moral rightness’ during an implicit association test (IAT). The incest IAT that was developed also deviated from standard explicit self-report measures in its specific content. Explicit attitudes have generally been measured towards a very specific case of ‘incest’. Most of the times researchers have used the standard case developed by Haidt et al. (2000), which describes one-time consensual sex between two adult siblings while using contraceptives. Instead, the incest IAT measured the automatic association between ‘incest’, as a conceptual construct, and ‘moral wrongness’. In other words, the test assessed moral biases against ‘incest’, stripped from all possible morally relevant and less relevant details, such as whether it is a one-time or a recurring act, or whether contraceptives were used or not.

When looking at the data, first of all, a statistically significant order effect was observed in the U.S. sample, with larger average D-score in the incongruent-congruent presentation order than in the congruent-incongruent presentation order. While the observation of order effects in the IAT is not desirable, it is more important to control for them in the statistical analyses, which we did. As discussed by Greenwald et al. (2003), the improved scoring algorithm, which was also used here, shows less resistance

to order effects than the conventional scoring algorithm (developed by Greenwald et al., 1998).

In all analyzed subgroups (i.e. U.S. incongruent-congruent, U.S. congruent-incongruent and Belgium), subjects showed significant biases in associating ‘incest’ with ‘morally wrong’. When comparing the effect sizes (i.e., the values of Cohen’s *d*) obtained in this study with its conventional standards (i.e., .2 equalling small, .5 medium and .8 large), overall a medium (Belgium: *d* = .53) to large (US, congruent-incongruent: *d* = .73 and incongruent-congruent: *d* = 2.71) effect size could be observed. However, it is arguably more fitting to compare the outcomes of this IAT with IATs focussing on related topics. In Table 16, we included a comparative overview of D-scores obtained in our study (in italics) and D-scores obtained by other studies including measures related, and unrelated, to sexuality or sexual identity. This table indicates that the implicit association of ‘incest’ with ‘moral wrongness’ is not remarkably larger compared to other implicit biases. In the Belgian sample, and for the U.S. congruent-incongruent presentation order, the differences in response latencies were even smaller than in the case of implicit preference for heterosexuals over homosexuals or the implicit association between disabled persons and unpleasantness.

Table 16 Comparative overview of IAT effect sizes in a selection of recent studies that use Greenwald et al.’s (2003) scoring algorithm

Implicit measures	D-value: MEAN (SD)	population sample and reference
<i>Implicit measures related to sexuality or sexual identity</i>		
<i>Implicit association of incest/morally wrong</i>	.24 (.43) (N=42) .65 (.24) (N=11) .27 (.37) (N=11)	Belgium USA (I-C) USA (C-I)
Implicit preference of heterosexuals over homosexuals	.51 (.41) (study 1, N= 176) .43 (.44) (study 2, N= 76) .49 (.41) (study 3, N= 90) .41 (.44) (study 4, N= 488)	USA Lai et al. (2014)
Implicit same-sex sexual attraction over opposite-sex sexual attraction	-.42 (.35) (heterosexual males, N= 79) .10 (.35) (heterosexual females, N= 139)	Canadian heterosexuals MacInnis & Hodson (2013)
<i>Implicit measures not related to sexuality or sexual identity</i>		
Implicit association of men/competence	-.18 (.30) (females, N= 21) .15 (.30) (males, N= 19)	Germany (Ebert et al. 2014)
Implicit association of women/ warmth	.42 (.40) (females, N= 136) .09 (.60) (males, N= 58)	Germany (Ebert et al. 2014)
Implicit association between disabled person/unpleasant	.65 (.25) (MDIAT ^a , N= 244) .58 (.41) (IATAD ^b , N= 244) .82 (1.21) (DAIAT ^c , N= 244)	USA Thomas et al. (2014)

^a Multiple disability IAT, ^b IAT for athletes with disabilities, ^c disability attitude IAT

Thus, implicit moral attitudes towards incest are less outspokenly negative than their explicit counterparts. Potentially this was due to the fact that subjects were not capable of consciously imagining the act. As such, these results are in accordance with the empathic disgust response hypothesis. Nonetheless, previous research has highlighted that implicit attitudes are more related to the affective rather than cognitive components of self-reported attitudes (see e.g. Smith & Nosek, 2011). As such, affective components – although these might be reduced in size – could still have influenced moral attitudes at the implicit level, for instance by a subtle disgust response evoked by quickly reading a word that describes a sexual act referring to sibling incest.

Additionally, the less outspoken rejection of incest at the implicit level might also partly be due to the suppression of socially desirable responding. As one of its greatest benefits, the IAT test subdues self-presentational strategies. Therefore, Greenwald and Krieger (2006) have argued that the assessment of implicit attitudes is of greatest interest when these are anticipated to deviate from their explicit counterpart. In other words, when it is applied to topics for which people are motivated to hide any biases they might have. In contrast, when it comes to incest aversion, cultural mechanisms are favoring strong opposition, which potentially motivates subjects to enlarge their consciously experienced biases when reporting on explicit attitudes. In other words, the incest IAT may have both suppressed a personal reinterpretation of the act as well as the effects of socially desirable responding. Nonetheless, as the incest IAT measured implicit attitudes towards ‘incest’, which was potentially most often interpreted as sexual abuse as this occurs much more often in society, we consider it doubtful whether a reduction in socially desirable responding would be entirely responsible for the lower implicit rejection of incest as opposed to its explicit counterpart.

Secondly we were interested in testing whether cultural differences in individual attitudes regarding incest would be detectable using an implicit test. Exploratory analyses indicated that significantly larger D-scores were obtained for U.S. vs Belgian subjects. In absolute numbers, the average D-score for U.S. subjects was twice the size of the average D-score in Belgian subjects (.46 and .23, respectively). Correspondingly, we obtained a large effect size in the U.S. sample (both orders) and only a medium effect size in the Belgian sample. So, the differences in IAT results went into the predicted direction of a stronger moral rejection of incest by U.S. subjects compared to their Belgian counterparts.

Finally, we also aimed to test for gender differences in implicit biases. In the Belgian sample, there was no significant difference in D-scores between males and females. As we described in the previous chapter, results have indicated mixed evidence regarding the presence of gender differences in explicit moral attitudes. Sometimes women report larger opposition (see e.g. Fessler & Navarrete, 2004, and Royzman et al., 2009), but

sometimes they do not (see e.g. Royzman et al., 2008, and Royzman et al., 2014b). Potentially, the gender difference in explicit attitudes to incest might be for the largest part due to a disparate degree of experienced sexual aversion when thinking of incest. This would explain why we don't find differences at the level of implicit attitudes. Nonetheless, a study of Geer & Robertson (2005) indicated that women, both at the implicit and the explicit level, more strongly associate words that refer to sexuality in general (e.g. clitoris, ejaculate, intercourse) with 'negative' than men. Gender differences will remain the focus of our attention in the next chapter.

Correlations between the implicit measure and explicit (i.e., self-reported) counterparts did not reach statistical significance ($p > .05$). Nevertheless, correlations were in the expected negative direction. Although the correlation of an implicit test and its explicit counterparts is often regarded as an indication of an IAT's construct validity, it is not that unusual for implicit attitudes and explicit counterparts to covary weakly or below level of significance (as discussed by, e.g., Lane et al., 2007, p. 77). To illustrate this point, a comparative overview of covariances between implicit measures and explicit counterparts in a selection of recently published studies involving attitudes towards sexuality, as well as this study (in italics) was included in Table 17. As stressed by Greenwald et al. (1998), who also reported low correlations between implicit and explicit measures, it is important to keep in mind that implicit and explicit attitudes essentially tap into different constructs (driven by the absence versus presence of conscious evaluative introspection, Greenwald and Banaji, 1995).⁸ However, and here we return to an important limitation of this study, one could also argue that the lack of a significant association between implicit and explicit measures indicates a genuinely reduced construct validity. Indeed, *sensu stricto* there was few conceptual overlap between target concept ('sibling incest') and target words (sexual acts) (see 'methods' section). Nonetheless, the instructions made it abundantly clear to subjects that any presented sexual act referred to sex between two siblings, and they were reminded of this prior to each experimental block.

⁸ The literature remains inconclusive about how to exactly interpret apparent differences and overlaps in underlying constructs of explicit and implicit attitudes (see Lane et al., 2007, pp. 83-84).

Table 17 Illustration of correlations between IAT and explicit counterparts in a selection of recent research involving sexuality measures

Implicit measures	Explicit measures	Pearson correlation coefficient (p-value)	Population sample and reference
<i>Implicit association of incest/morally wrong</i>	<i>How disgusting and morally wrong is onetime consensual sex between adult siblings?</i>	<i>IAT & disgusting: -.22 (.163) IAT & moral wrongness: -.09 (.575)</i>	<i>USA/Belgium females</i>
Implicit association of sexuality and 'negative'	Sexual Opinion Survey	-.026 (ns)	USA Geer & Robertson (2005)
sexual older adult IAT ^a	sex and ageing attitudes brief sexual attitudes scale Fraboni scale of ageism	.12 (ns) .20 (<.05) .05 (ns)	Canada Thompson et al. (2014)
ageing sexual IAT ^b	sex and ageing attitudes brief sexual attitudes scale Fraboni scale of ageism	-.01 (ns) .01 (ns) .02 (ns)	

^a general activities vs. sexual activities amongst older adults, ^b young people vs. older people engaging in sexual activities

If more and more evidence can be collected in support of the empathic disgust response hypothesis, this would imply that the moral rejection of consensual sex between adult siblings will prove very hard to be eliminated (since firmly grounded in personal sexual aversions). Nonetheless, there is also evidence at hand that cultural proscriptions (see chapter 6, and also the attested difference here between Belgian and U.S. subjects) and cognitive processes (see also chapter 6) can influence these attitudes as well. Therefore, we conclude that it would be worth testing whether the moral rejection of consensual sex between related adults can be mitigated. To our knowledge, it has not yet been tested whether people are willing to, or even capable of, adopting a more mitigated stance towards romantic relationships between consenting adult siblings. The study outlined in the final chapter of this dissertation aims to provide an onset to answering this question.

Chapter 8 The malleability of moral attitudes towards consensual sex between adult relatives

8.1 Introduction

The study described in the previous chapter indicated that, although incest might be strongly morally rejected at the explicit level, implicit attitudes (i.e. attitudes measured outside of conscious control or introspection) are much less outspokenly negative. This result aligns with the empathic disgust response hypothesis, which links moral judgments to personal sexual aversions. During an implicit association test, subjects lack the time to consciously imagine the act as if would happen to themselves, and as a consequence, the extent of experienced sexual aversion should be strongly reduced. If personal sexual aversions indeed strongly feed into our moral attitudes about incest, then one should find less outspokenly negative attitudes towards incest at the level of implicit attitudes, which we did. Although intuitive moral decisions about incest might be strongly driven by personal sexual aversions, the empathic disgust response hypothesis does not exclude the influence of cultural proscriptions (Fessler & Navarrete, 2004). This account is also not irreconcilable with empirical findings indicating that cognitive processes as well may affect these judgements (e.g., attitudes are also predictable by individual proneness to rational thinking, Royzman et al., 2014b).

Therefore, the question that still remains is how feasible it would be for people to adjust their moral attitudes towards consensual sex between adult siblings. This topic warrants a closer look in light of the issues concerning the rational justifications for legal prohibitions on consensual sex or marriage between adult relatives (discussed in chapter 5). So far, the closest that researchers have come to testing the malleability of these moral attitudes was investigating subjects' considerations about mitigating circumstances for incestuous behavior (Piazza et al., 2013). An adequate test however entails attitude measurements at different points in time, and so far researchers have always been asking participants' opinions at a single point. As discussed in chapter 6

(section 6.1.1), it has been suggested that moral attitudes regarding consensual sex between adult siblings are in the first place intuitive and emotionally-driven (see, e.g., Haidt et al., 2000). Following this account, rational considerations are, first and foremost, nothing more than ‘post-hoc’ rationalizations of intuitive judgments. However, recent research pointed out that cognitive processes might be involved to a greater extent than was previously assumed (e.g., intentionality of the actors is also taken into account, Young & Saxe, 2011).

If moral decision making about incest is in the first place an intuitive process, then the malleability in explicit moral attitudes could for instance be tested by directly manipulating subjects’ emotional state. Likewise, it has recently been shown that the experimental induction of moral elevation¹ reduces both implicit and explicit prejudice against homosexuals (Lai et al., 2014). However, the empirical study that we wished to perform here is specifically framed within the more broader aim of testing which practical strategies can be applied in society to reduce the stigmatization of adult kin involved in a consensual relationship (see chapter 5). Having this aim in mind, it is obvious that, from an ethical point of view, it would be highly undesirable to manipulate personal sexual aversions for close kin.

So, instead, we applied a strategy that tried to change such attitudes influencing cognitive processes, including the perception of cultural proscriptions. Specifically, an educational intervention was used as the experimental manipulation in this study. During this intervention phase, subjects were provided with background information about the moral psychology of incest aversion (including its evolutionary origins), and were informed about the questionable rationales of the legal provisions against consensual incest between adults. The experimental set-up comprised of three attitude measurements in a group setting, the first two taking place at the same day and the third one taking place four weeks later. At the start of the experimental procedure, attitudes were measured a first time, followed by the educational intervention briefly described above (see also methods section). Consequently, attitudes were measured again. After four weeks, a third and last measurement was carried out, in order to test for any long-term effects in attitude change. The core question was whether, and to what extent, the educational intervention would change moral opinions immediately after the information was provided, and if these changes would be stable over time (i.e. over 4 weeks).

During the first phase of data collection, we subjects also reported degree of experienced curiosity, anger, sympathy, disgust, and fear. Based on previous research

¹ Moral elevation is an emotional sensation that is felt when experiencing acts of moral beauty, such as charity, gratitude or generosity (Lai et al., 2014, p. 782).

(e.g., Fessler & Navarrete, 2004; Gutierrez & Giner-Sorolla, 2007; Royzman et al., 2008), we expected that experienced disgust and anger towards the act would be positively associated with moral opposition. Additionally, we aimed to test whether emotional experience on the one hand, and rational vs. intuitive thinking style on the other hand, would be associated with attitude malleability. Also during the first phase of data collection, we asked subjects to give their opinion about whether or not sex and marriage between consensual adult siblings should be legal. Subjects who judged that it should be illegal were asked to motivate this decision with the argument they considered as most important. Subsequently, we planned to test whether subjects who made reference to harm would adjust their moral attitudes to a different degree than subjects who made reference to a non-harm related argument. Finally, we aimed to test for gender differences in initial moral opposition and attitude malleability.

8.2 Methods

8.2.1 Participants

Subjects were recruited during class at the Law Faculty of Ghent University. The experiment was integrated in a regular class session, since the information provided during the intervention phase was part of the students' curriculum. Participants were all first bachelor students in criminological science, which means that the majority had just graduated from high school. A control question was added to one of the questionnaires, asking whether the student had already followed this course in a previous academic year. If this was the case, the student's data were excluded from further analysis. Participation to the study was entirely voluntary and anonymous. Students were free to refrain from participating at any time, or could opt not to fill out the questionnaires in the first place. Subjects did not receive financial compensation for participating. Only data of participants who fully participated in all three phases were included in the analyses ($N = 104$, age mean \pm SD = 18.54 ± 1.33 , 74% females).

8.2.2 Materials

8.2.2.1 Phase I questionnaire

First, information on gender, age and sexual orientation was collected. After this, participants completed a 10-items short version of the Rational-Experiential Inventory

(REI) (Epstein et al., 1996). This scale maps self-reported thinking style by measuring two components: need for cognition and faith in intuition. It has been widely applied in psychological research and includes items as: 'I try to avoid situations that require thinking in depth about something' (i.e. component of need for cognition) and 'I trust my initial feelings about people' (i.e. component of faith in intuition). The higher the score on the REI-scale, the more people have faith in their intuitions. Subsequently, subjects were presented with a Dutch translation of a scenario that was originally developed by Haidt, Bjorklund and Murphy (2000) (see also Haidt, 2001) which has been used often in research studying the moral psychology of incest aversion.

Julie and Mathias are two college students and brother and sister, they share both biological parents. Last summer they backpacked to France. One night, during conversation in their tent, they decided that it would be interesting and fun to have sex with each other. Julie was taking birth control pills, but Mathias used a condom too, just to be safe. They both enjoyed having sex with each other, but they decided not to do it again. They kept that night as a special secret, which made them feel as siblings even closer to each other than before.

The participants answered the following questions:

- A. While reading this scenario, to what extent did you experience the following emotions: curiosity, anger, sympathy, disgust, and fear? (each emotion was evaluated on a Likert-type scale: 1 = not at all, 7 = very much)
- B. How morally permissible do you find Julie's and Mathias' behavior? How morally permissible would you find it for Julie and Mathias to marry each other? (Likert-type scale: 1 = not at all permissible, 7 = completely permissible).
- C. Should it be legal for adult full siblings, like Julie and Mathias, to have mutually consented sex? (Yes/No) If you think that it should be illegal, what is your most important reason to think so? (open-ended question) Should it be legal for adult full siblings, like Julie and Mathias, to marry each other? (Yes/No) If you think that it should be illegal, what is your most important reason to think so? (open-ended question)

8.2.2.2 Phase II questionnaire

On a different form, subjects again completed question B of phase I (see above).

8.2.2.3 Phase III questionnaire

A variant of question B that was used in phases I and II, was administered: 'How morally acceptable is it for full siblings to have sex once?' and 'How morally acceptable is it for full siblings to marry each other?'.

8.2.2.4 Information provided in the educational intervention phase

First, the lecturer gave a brief overview of Belgian and European laws on consensual sex and relationships between adult close family members. Then, he presented the arguments in support of such laws, and summarized critical remarks to them (cf. chapter 5, sections 5.2 and 5.3). Also, summarizing information was given regarding the biological origins of human incest aversion (cf. chapter 1, section 1.2). All this was presented in an objective, non-persuasive way.

8.2.3 Procedure

The three phases were collected in the above-mentioned order (I-II-III), making use of paper-and-pencil questionnaires. Participants completed phases I and II during the same class. Four weeks later, participants completed phase III, again during class.

At the beginning of the first session, it was announced that students could voluntarily take part in a survey study. It was explained that no reimbursement would be given, and that participation was entirely anonymous. Students were made sure that the decision (not) to take part, or any answer given on the survey, would not affect their grades in any way. If taking part, it was asked to fill out the survey honestly and not to discuss any answers with their fellow students. While filling out the survey, researchers walked around and intervened in case students started talking. Students were explained that three surveys would be filled out: one before starting class, one after half an hour, and one at the start of a different class four weeks later. Students were reminded again that they could opt out at any time.

After the procedure was explained, the first questionnaire was handed out. Students were asked to mark each of their questionnaires with the last four digits of their cell phone number, to enable anonymous but efficient subject identification across different surveys. After completion of the first questionnaire, which took about 5 minutes, all materials were collected. Immediately hereafter, students listened to their regular lecturer explaining the information described above in the materials section. While giving this explanation, the lecturer was visually assisted by a PowerPoint presentation, which summarized the most essential information. After this explanation, which took approximately 30 minutes, the second questionnaire was handed out and completed.

This again took about 5 minutes. After collecting all surveys, the researcher left and regular class went on.

The third phase of the study took place exactly four weeks after phases I and II, during another class. Survey completion took about 5 minutes. After completion, students were debriefed.

8.3 Results

8.3.1 (Change in) moral judgments

The figures below display mean values and standard deviations of moral attitudes towards one-time consensual sex between adult siblings (figure 24) and moral attitudes towards marriage between siblings (figure 25), over the three experimental phases.

In all phases, moral attitudes regarding sex and marriage between siblings correlated significantly (phase I: $r = .55$, $p = .000$, $N = 103$; phase II: $r = .66$, $p = .000$, $N = 101$; phase III: $r = .63$, $p = .000$, $N = 103$). Paired-samples t -tests showed that sexual contact was judged to be less morally wrong than marriage (phase I: $t(101) = 5.96$, $p = .000$; phase II: $t(100) = 4.08$, $p = .000$; phase III: $t(102) = 4.45$, $p = .000$). Subjects who judged that consensual sex between adult siblings should be illegal ($N=23$ or 22%) considered the act as more morally wrong than subjects who judged that this behaviour should not be subjected to legal constraints ($N= 80$ or 88%) ($t(101)= 4.10$, $p= .000$) (figure 26). Likewise, subjects who judged that marriage between adult siblings should be illegal ($N= 78$ or 75%) considered the act as more morally wrong than subjects who judged that this behaviour should not be subjected to legal constraints ($N=24$ or 25%) ($t(100)= 5.93$, $p= .000$) (figure 27).

Moral attitudes regarding sexual contact between siblings changed significantly over the three phases (repeated measures ANOVA: $F_{2,196} = 8.67$, $p = .000$). It was found to be less morally acceptable in phase I compared to phases II and III. Moral opinions in phases II and III did not significantly differ. A paired samples t -test was performed on responses of phases I and II, in order to calculate the effect size and power of the experimental manipulation. This test ($t(99)= -3.13$, $p= .002$) indicated an effect size (Cohen's d) of .31, which is a small to medium effect size according to standard conventions (Cohen, 1988: cut-offs for small, medium and large effect sizes are respectively .2, .5 and .8). Observed statistical power ($1-\beta$) was .92.² Participants' moral attitudes on sibling marriage also

² Statistical power was calculated using the software program G*Power (Faul et al., 2007).

significantly altered over the phases ($F_{2,196} = 14.33, p = .000$), displaying the exact same trend. Again, only a significant difference was observed between attitudes of phases I and II. Here, the paired samples t-test of responses in phases I and II ($t(99) = -4.82, p = .000$) indicated an effect size (Cohen's d) of .48, which is a medium effect size. Observed statistical power ($1-\beta$) was .99.

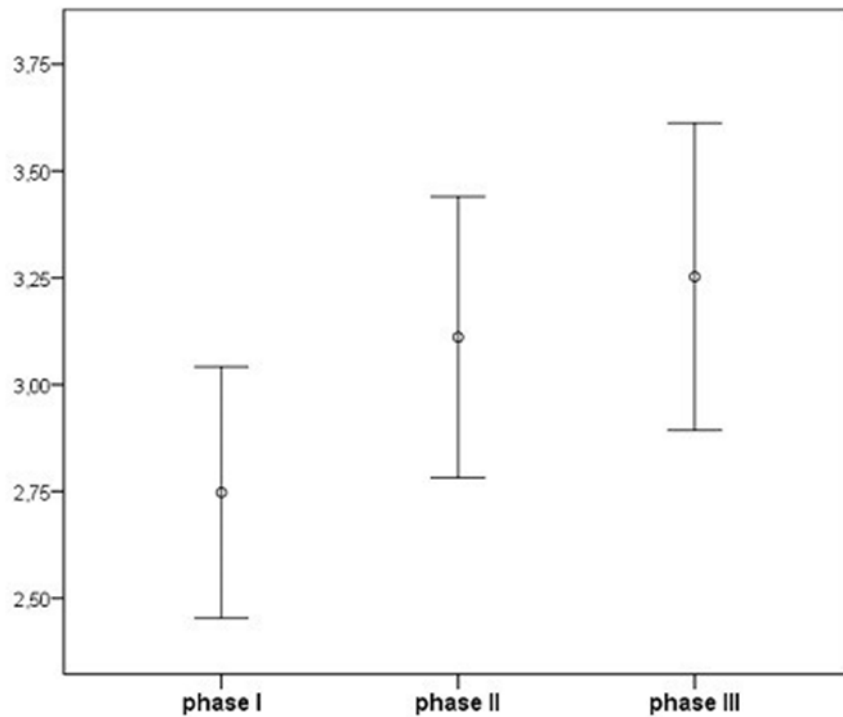


Figure 24 Mean values and standard deviations of moral attitudes towards consensual sex between adult siblings, displayed for each experimental phase.

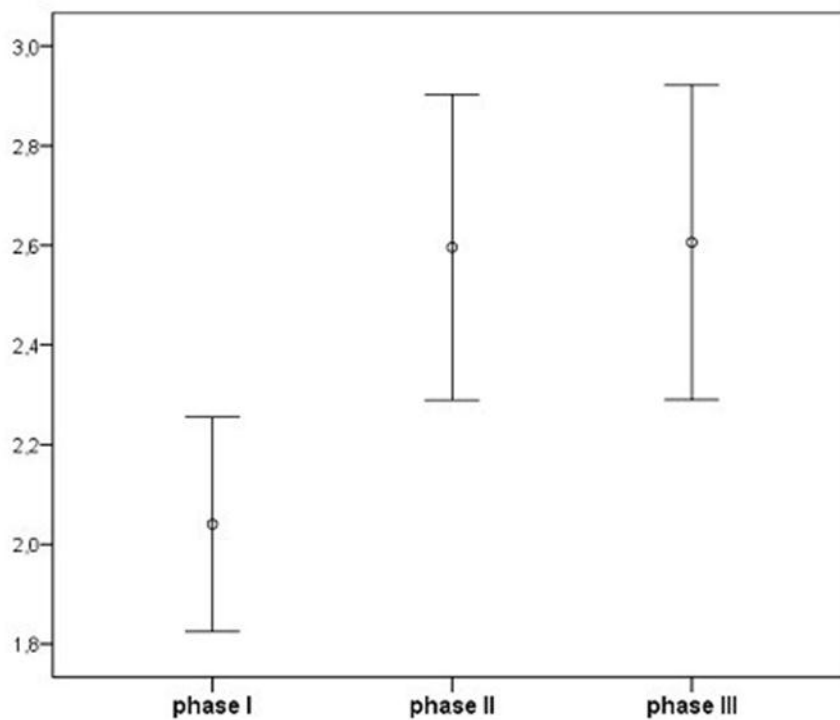


Figure 25 Mean values and standard deviations of moral attitudes towards marriage between adult siblings, displayed for each experimental phase.

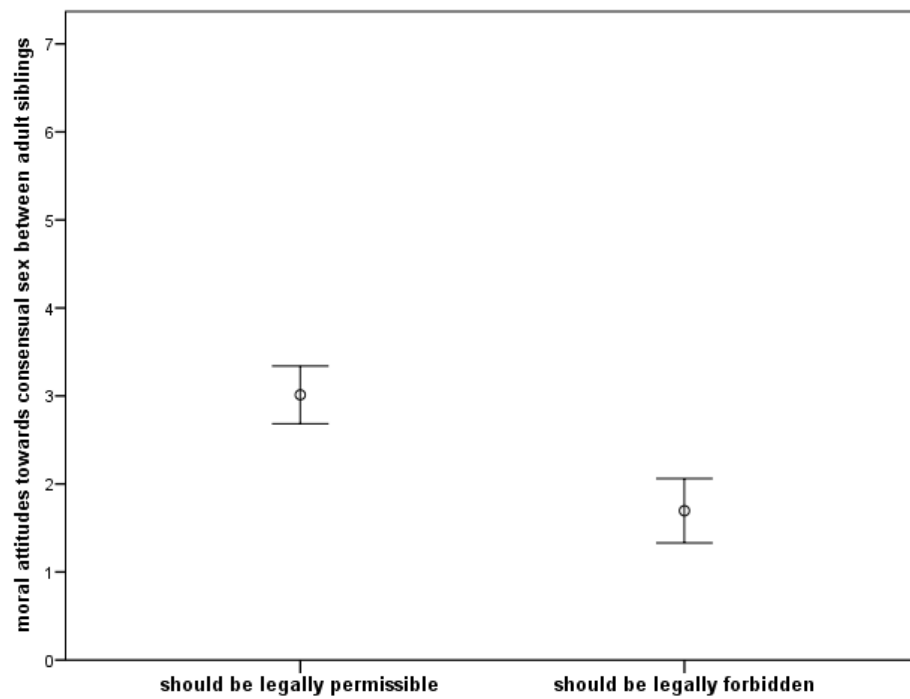


Figure 26 Mean values and standard errors of moral attitudes towards consensual sex between adult siblings: comparison of attitudes depending on legal views.

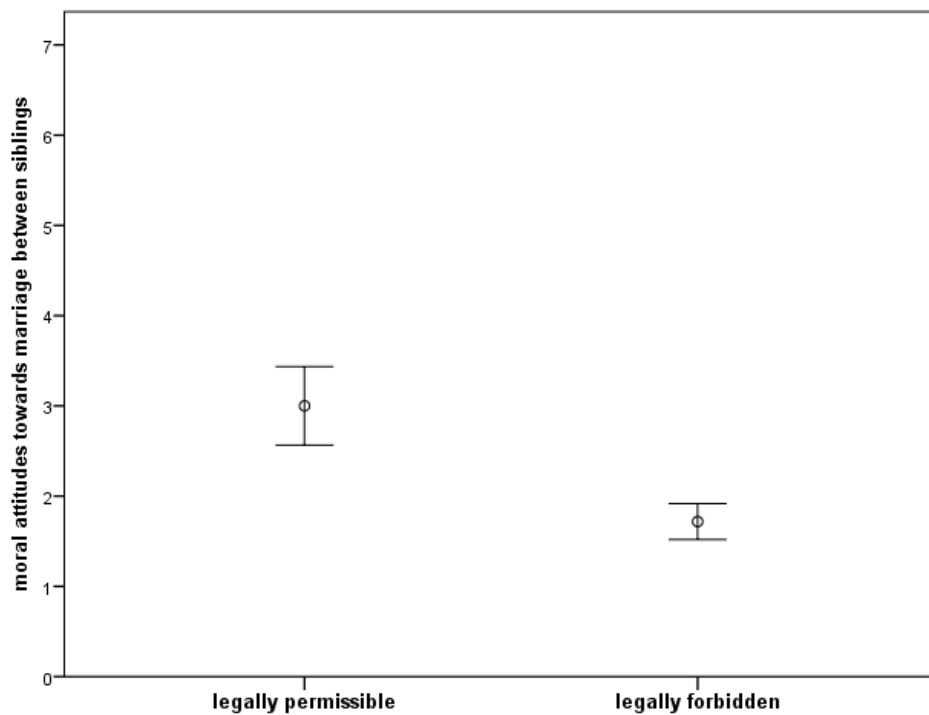


Figure 27 Mean values and standard errors around the mean of moral attitudes towards marriage between adult siblings: comparison of attitudes depending on legal views.

8.3.2 Predictors of (changes in) moral judgments

We aimed to identify the variables that correlate with moral judgments in phase I, and those that correlate with changes in moral judgments in phase II. To obtain an indication of changes in moral attitudes, we calculated two new variables, by subtracting the values of phase I judgments from the values of phase II judgments: sex phase II-I (mean \pm SD = .36 \pm 1.15) and marriage phase II-I (mean \pm SD = .55 \pm 1.14).

8.3.2.1 Emotional experience

Immediately after reading the scenario in phase I, participants mainly reported experiencing disgust (mean \pm SD = 5.06 \pm 1.72). The strength of all other assessed emotions was much lower: curiosity (mean \pm SD = 2.14 \pm 1.42), fear (mean \pm SD = 1.78 \pm 1.46), anger (mean \pm SD = 1.68 \pm 1.20) and sympathy (mean \pm SD = 1.54 \pm .94).

The intensity of each of these emotions correlated with moral attitudes regarding adult consensual incest in phase I (see table 18). A linear regression model identified disgust, curiosity and anger as significant predictors of moral opposition against sexual contact between siblings ($F_{3,100} = 16.76$, $R^2 = .34$, $p = .000$). Curiosity and anger, but not disgust, significantly predicted moral attitudes regarding sibling marriage ($F_{2,100} = 11.56$, $R^2 = .19$, $p = .000$). Reported disgust in phase I correlated significantly, i.e. negatively, with change in moral attitudes regarding sexual contact between siblings in phase II (sex phase II-I: $r = -.25$, $p = .000$). There was no significant correlation between any of the emotions and changes in moral attitudes regarding marriage between siblings in phase II.

Table 18 Pearson's Correlation Coefficients of Moral Attitudes regarding Consensual Sibling Incest and Self-Reported Emotional Intensity

		<i>Curiosity</i>	<i>Anger</i>	<i>Sympathy</i>	<i>Disgust</i>	<i>Fear</i>
Phase I	sibling sex	.42***	-.42***	.31*	-.43***	-.33**
Phase I	sibling marriage	.32**	-.36***	.18	-.27**	-.29**

* $p < .05$

** $p < .01$

*** $p < .001$

8.3.2.2 Rational versus Intuitive thinking style

Rational versus intuitive thinking style was not associated with moral attitudes towards consensual sex between adult siblings ($r = -.16$, $p = .117$, $N = 103$), nor with moral attitudes towards marriage between adult siblings ($r = -.10$, $p = .329$, $N = 103$). Also, changes in moral

attitudes were not associated with self-reported tendency to think in a rational vs. intuitive way (sex phase II-I: $r = -.04$, $p = .694$, $N = 100$; marriage phase II-I: $r = -.01$, $p = .914$, $N = 100$).

8.3.2.3 Harm

Of those subjects who judged during phase I that consensual sibling sex should be illegal, 80% ($N = 12$) stated that harm (inferred to the actors themselves or to others in their environment) was the principle reason to make the act illegal. For sibling marriage in phase I, this was 69% ($N = 37$).³

Values on the variable sex phase II-I did not differ between people who did and did not mention harm as the principle reason to legally oppose consensual sex between siblings in phase I (independent samples t-test: $t(12) = .31$, $p = .761$). Likewise, values on the variable marriage phase II-I did not differ between people who did and did not mention harm as the principle reason to legally oppose sibling marriage in phase I (independent samples t-test: $t(49) = .67$, $p = .508$).

8.3.2.4 Gender

In phase I, male and female subjects did not significantly differ in moral attitudes regarding sexual contact between siblings (independent samples t-test: $t(101) = -.37$, $p = .714$) and marriage between siblings ($t(101) = .15$, $p = .878$). Also, males and females did not differ in changes in moral attitudes in phase II (sex phase II-I: $t(98) = .92$, $p = .360$; marriage phase II-I: $t(98) = 1.14$, $p = .257$).

Males and females did not differ in emotional intensity (curiosity: $t(99) = -.12$, $p = .907$; anger: $t(99) = 1.81$, $p = .073$; sympathy: $t(100) = 2.30$, $p = .089$; disgust: $t(100) = -.60$, $p = .553$; fear: $t(99) = 1.22$, $p = .227$).

8.4 Discussion

Moral psychological research has hitherto suggested that there is strong moral opposition against sex and relationships between related adults, even when it involves mutual consent. Such opposition goes along with emotional experiences of disgust and,

³ Other reasons that were given to motivate why sibling incest should be illegal referred to societal disapproval, the unnaturalness of the act or to the act 'simply being wrong'.

to a lesser extent, anger, and are hypothesized to be strongly driven by intuition. Nonetheless, rational considerations, such as harm and intentionality, have also been shown to be predictors of moral opposition against consensual sex between adult relatives. We argued that studying the malleability of moral attitudes concerning consensual sex and relationships between related adults, on itself, would prove informative in the light of further legal debate concerning laws aiming to discourage such behavior.

In this study, we surveyed the moral opinions of young adults, in order to answer the following questions: (1) can moral judgments regarding consensual adult incest be mitigated? (2) if so, do emotional experience, putting much weight to the presence of harm or subject's gender predict such changes? Moral opinions were measured at three points in time. First, at the beginning of the experimental procedure, subsequently, after having received legal, moral psychological and biological/evolutionary psychological background information regarding human incest aversion, and finally, four weeks later, in order to test for any long-term effects in attitude change.

Results indicated that participants indeed mitigated their attitudes regarding consensual sexual relationships and marriage between adult siblings. On average, subjects continued to morally reject both consensual sexual contact and marriage between siblings, but to a significantly lesser extent than before the educational intervention. After the educational intervention phase, we observed small to medium (consensual sex between siblings) and medium (sibling marriage) effect sizes in attitude change. Interestingly, this mitigation was stable over a period of four weeks.

Earlier studies showed mixed evidence regarding gender differences in moral attitudes about consensual adult sibling incest (e.g., present in Fessler & Navarrete, 2004, and Royzman et al., 2009, but absent in Royzman et al., 2008, and Royzman et al., 2014b). Here, we also did not attest gender difference in moral attitudes regarding consensual adult sibling incest, or self-reported disgust. However, this might partly have been due to a relatively low representation of males in the subject sample (27 males, as opposed to 77 females). As for emotional experience, both self-reported anger and disgust were significantly associated with a stronger moral rejection of consensual incest. This result conforms with previous empirical studies targetting the role of anger and disgust in the context of attitudes regarding incest (Fessler & Navarrete, 2004; Gutierrez & Giner-Sorolla, 2007; Piazza, et al., 2013). Interestingly, our study revealed that only the strength of initial disgust (but not anger) is significantly negatively associated with attitude change. It was also found that curiosity about the scenario, a positive emotional compound, was associated with less negative moral attitudes regarding consensual incest.

What can be deduced from these results about the processes that led to a significant change in moral attitudes? Potentially, the educational intervention led to a cognitive reappraisal of the reasons for considering it as being morally wrong. Strategies were

built in to analyze post-experimentally whether this process was mainly responsible for attitude change (see Table 19). In phase I, we asked subjects whether sexual behaviour on the one hand and marriage on the other hand, should be legally permissible or not. Subjects who judged that it should be illegal were subsequently asked to think about the most important reason why this should be the case. We attested that a large amount of subjects mentioned the presence of harm (to the actors or to their families) as the principle reason. Subsequently, the experimental manipulation (intervention phase) explicitly addressed the weakness of harm-related arguments in the defense of laws that aim to discourage such behaviour⁴. Therefore, if the experimental manipulation would have mainly brought about change due to the cognitive reappraisal of harm-related arguments, then subjects who mentioned harm should have adjusted their moral attitudes to a larger extent than subjects who mentioned a reason that was not explicitly attacked during the educational intervention phase (these were: societal disapproval, the act being ‘unnatural’ or to the act ‘simply being wrong’). However, this was not the case. As such, the cognitive reappraisal of harm-related arguments may have been involved but was not what crucially happened during the phase of moral attitude change.

Table 19 Is a cognitive reappraisal of harm-related arguments mainly responsible for changes in moral attitudes?

PHASE I	INTERVENTION	PHASE II	PHASE III
Moral attitudes about consensual sex and marriage between siblings show to be associated with legal views	Background information about the evolved origins of human incest aversion as well as	Moral attitudes display significant mitigation	
Principle reason for judging that the act should be illegal: <ul style="list-style-type: none"> • Harm-related argument • Non-harm related argument 	Critical assessment of the validity of harm-related arguments in support of legal prohibitions	Focusing on subjects who argued that consensual incest should be illegal in phase I: Moral attitude change was not larger in subjects who gave a harm-related argument in phase I, compared to those who gave a non-harm related argument	

⁴ For instance, it was explained that consensual sex between adult siblings should not explicitly lead to genetic or social harm.

Another or additional possibility is that by explaining the biological origins of incest aversion, people come to understand that under normal conditions siblings spontaneously develop a sexual aversion for each other. By extent, in those very rare occasions that it does occur, it would probably indicate that something went wrong during the spontaneous development of this aversions (e.g., due to prolonged separation during childhood). Maybe a deliberate consideration of the special circumstances that may lead to consensual incest may have caused subjects to adjust their moral condemnation. Nonetheless, if such cognitive deliberation would be mainly responsible for attitude change, then one would expect to observe associations between proneness to rational vs. intuitive thinking style and changes in moral judgments, which we did not find (this in contrast with Royzman et al., 2014).

Lastly, the experimental manipulation may have led to a change in moral attitudes by creating a temporary social climate in which ‘incest’ not necessarily equals to ‘morally wrong’. Potentially, ‘incest’ may be so strongly tabooed that people expect that having neutral moral attitudes towards consensual sex between adult relatives would be strongly condemned by one’s social environment. Potentially, these expectations also affect self-reported, albeit anonymous, attitudes on this topic. By attacking the reasons in support of legal constraints, the intervention may have manipulated these social expectancies concerning the general consensus about the moral wrongness of consensual incest. Needless to say, making a strong claim for this interpretation requires further research. In any case, the experimental intervention brought about substantial additional thought and discussion among subjects. In phase III, we asked subjects how often they had thought about the topic during the last month, and how often they had discussed it with others. Only 36% of subjects indicated not to have thought about the topic again during the last month, and only 30% indicated not to have talked about it with anyone. Of those subjects who reported to have discussed the topic with others (i.e., 70% of the subject sample), 20% did so with a parent/parents, 10% with a sibling/siblings, 20% with friends who did not participate in the study and 46% with friends who participated in the study.

Summarizing, although the results obtained here are informative in the light of bringing about potential change in individual attitudes towards consensual relationships between related adults, we fully acknowledge that this study was mainly explorative within the broader aim of studying attitude change. As for now, we can only make some educated guesses about the potential processes that caused a significant mitigation in moral attitudes. Most importantly, however, is that we indeed attested that attitudes towards consensual incest show to be flexible, which is a relevant insight to those who wish to see the criminalization and stigmatization of this behaviour being changed.

Summary and conclusion

In this second part we started out by summarizing the recent legal science literature on the prohibition of consensual sex and relationships between adult family members (chapter 5). We concluded that the arguments for considering shared family membership as an exclusion criterion for partner choice are very questionable. Nonetheless, there is currently little political or societal discussion going on regarding which would be preferential: the status-quo, the abolishment or the reformation of such laws. This situation, however, might change in the (near) future (cf. as illustrated by the report of the Deutsche Ethikrat, 2014), potentially driven by the developments in reproductive technology and changes in the structure of the nuclear family. For those wishing to advocate reform or even abolishment, it is most relevant to know whether people are even capable of mitigating their moral and legal opinions regarding sexual behavior and romantic relationships between consenting adult family members to begin with. This very issue was further explored in the three chapters that followed.

In chapter 6 we described current investigations on the moral psychology of incest aversion. These indicate that moral attitudes towards consensual sex between adult siblings are typically accompanied by disgust. Whether such a disgust response is fed by personal sexual aversions (i.e., the empathic disgust response hypothesis), or whether they are the result of moral decision making (i.e. the cultural psychological hypothesis) needs additional investigation. In any case, evidence has also been reported for the involvement of cognitive processes during moral decision making about incest. Based on these findings, and having in mind the issue described in chapter 5, we decided to proceed with two empirical studies, one further exploring the validity of the empathic disgust response hypothesis vs. the cultural psychological hypothesis (chapter 7), and one exploring the malleability of moral attitudes about consensual sibling incest (chapter 8).

Table 20 provides an overview of the research questions, methods and results of the empirical studies described in chapters 7 and 8.

The study described in chapter 7 aimed to investigate the implicit moral rejection of incest, by testing the association strength of incest with moral wrongness in an implicit association test (IAT). Results indicated that the moral rejection of incest is much less outspoken at the implicit than the explicit level, with only moderate effect sizes in e.g.

Belgian subjects. We concluded that subjectively felt sexual aversion might indeed play an important role when reporting on attitudes at the explicit level (i.e., conform the empathic disgust response hypothesis).

In chapter 8, an experiment was developed specifically for testing the malleability of moral attitudes towards consensual sex and relationships between related individuals. By an educational intervention phase we were able to bring about a significant mitigation in subjects' moral rejection of this behaviour, and this both in the short term (immediately after the intervention) and in the long term (one month later).

What inferences can be drawn from these insights with regard to legal practices? In chapter 5, distinction was made between the status-quo position and the adjustment position on laws dealing with consensual sex and relationships between adult relatives. The status-quo position makes a case for maintaining existing civil and criminal legislation, while the adjustment position makes a case for modifying these laws based on the overall weak quality of its rational justifiability. The results obtained in the second part of this dissertation allows defenders of the adjustment position to argue that legal change is not unfeasible from a moral psychological point of view. We attested a significant decrease in moral rejection of consensual relationships between adult siblings, which may potentially concur with participants being less supportive of such laws, and in addition, display increased social acceptance of this behaviour.

Although these results remain explorative, some basic strategies for tackling the current moral climate can be derived from them. For example, dissemination of scientific knowledge could play a crucial role in creating a social atmosphere in which it is more acceptable to think about consensual sex between adult relatives as a permissible form of partner choice in modern society. As suggested by for instance Scheufele (2014), science communication is a form of political communication: sharing scientific facts and realities with the lay public can indirectly alter the public's understanding and perception of reality. In this case, communicating scientific facts concerning the moral psychology of incest aversion¹ can increase the public's understanding of the origins, as well as the poor argumentative support, of the current social inacceptability of consensual forms of sexual behavior and relationships between adult relatives. Of course, making this an effective strategy is not the responsibility of scientists solely. As always, news media create a 'mediated reality' that can be quite different from the objective reality, depending for instance on the current political

¹ Looking at the field of evolutionary psychology, efforts are made for scientific insights to find their way to societal and legal applications. Tybur and Griskevicius (2013) for instance recently wrote an article in a public administration journal about 'naturally effective' strategies (i.e. strategies that are easily adoptable due to properties of our evolved psychology) that may help dealing with an array of societal problems (e.g. promoting a healthy diet).

climate.² Nonetheless, being relevant stakeholders, scientists³ can aim to promote agenda building in favor of more objective reports in the media when it comes to consensual relationships between adult family members.

Again, the domain of attitude change in the context of consensual incestuous relationships requires further effort and additional methodological refinement. Importantly, in future studies, one should aim to include populations outside of an educational (university) context. Bearing in mind experimental validity while addressing broader subject groups however, it will be required to think of complementary methods, for instance by developing intervention techniques that make use of standardized computer tutorials. We have only provided a small contribution within much broader research efforts to crosspollinate the fields of moral psychology and socio-legal research. We nevertheless hope that this contribution may inspire additional research serving future dynamics in the social stance towards consensual sex and relationships between adult relatives.

² In appendix 5 we included an illustration of the way consensual incest is typically mediated in Belgium at the moment of writing.

³ With ‘scientists’ we refer to those legal scholars in specific who are convinced that there are insufficient reasons to uphold legal provisions against consensual forms of sexual behavior

Table 20 Summary of research questions, methods and results of the studies described in chapters 7 and 8

CHAPTER		RESEARCH QUESTIONS (A) AND METHODS(B)	RESULTS
<p>Testing the empathic disgust response hypothesis</p>	Chapter 7	<p>QUESTIONS</p> <p>(1) Is sibling incest morally opposed at the implicit level?</p> <p>(2) Are gender differences detectable?</p> <p>(3) Are cultural differences detectable?</p> <p>METHODS</p> <p>Implicit Association Test: testing for the biased association of 'sibling incest' with 'moral wrongness' as opposed to 'moral rightness'.</p>	<p>(1) Yes, with a moderate (Belgian sample) to strong (U.S. sample) effect size</p> <p>(2) No</p> <p>(3) Yes</p>
	Chapter 8	<p>QUESTIONS</p> <p>(4) Can explicit moral opposition against consensual sibling incest be mitigated by an educational intervention strategy?</p> <p>(5) Is attitude change possible in the short and the long term (after 1 month)?</p> <p>(6) Are gender differences in attitude change detectable?</p> <p>METHODS</p> <p>Survey study with an experimental manipulation: collection of self-reported attitudes before and after information is provided about human incest aversion and the legal constraints on consensual relationships between adult kin.</p>	<p>(4) Yes, with a small to moderate effect size</p> <p>(5) Yes</p> <p>(6) No</p>

Conclusion

In this dissertation we investigated the human sexual aversion for sibling incest (part 1), the prohibition on consensual sex between adult siblings in current western society and the related individual moral attitudes (part 2). At the end of each chapter and at the end of both parts, we already condensed our findings in the form of conclusions to that specific section. Therefore, we will limit ourselves here to a concise summary of our most important findings, while adding some general thoughts.

In part 1, sexual aversions for sibling incest were looked at through the lens of evolutionary theory, and we concluded that considerable evidence has been gathered for the evolutionary psychological hypothesis which states that these aversions can be predicted through evolved cues for sibling detection. We argued for the utilization of an additional methodological approach for studying these aversions, and subsequently implemented this approach in three empirical studies. The first two studies reconfirmed the evolutionary psychological hypothesis described above (in women), but results also suggested the additional importance of explicit instructions (in men). The third study indicated that for a facial disgust expression to be detected, more is required than the subtle suggestion of incest. Although the human sexual aversion for incest is undoubtedly deeply psychologically embedded, the conscious consideration – i.e., the explicit imagination of the act – might still be essential for an aversive response to be evoked.

At the end of part 1, we explicitly discussed the relevance of these findings for future research in the domain of sexual aversions for incest. However, apart from the scientific value of these investigations, research of this kind might also have clinical relevance, an aspect that so far we paid little attention to. Some time ago, Parker and Parker (1986), and later on, Williams and Finkelhor (1995), collected data that suggest an association between paternal caregiving and a decreased chance of paternal child sexual abuse. Williams and Finkelhor (1995) investigated a subject sample of fathers with a biological daughter, of which half were explicitly selected on the basis of having committed sexual abuse with this daughter during her childhood. All subjects completed a questionnaire about typical parental caregiving activities during the daughter's childhood (e.g.,

bathing, dressing, helping with homework, etc.), from birth until the age of 5. It was shown that incestuous biological fathers displayed significantly lower caregiving behaviour towards their daughters than non-incestuous biological fathers, and this for all age intervals from birth until the age of 5. This relation remained robust when controlling for fathers' average time spent away from home due to job responsibilities, having been the victim of childhood sexual abuse themselves, having been rejected by their own father during childhood and marital dissatisfaction. Alternatively, it may be the case that pedophilic sexual interest negatively influences willingness to be involved in childrearing behaviour. However, Williams and Finkelhor (1995, p. 110) pointed out that "according to the accounts of some of the incestuous fathers, they engaged in high levels as caretaking as part of the 'grooming' process in which they readied the daughter for sexual involvement". So, incestuous fathers do seem to be interested in being involved in caretaking processes, however, it may be part of the process of initiating sexual behaviour. Therefore, pedophilic interests potentially overpowers spontaneous mechanisms for incest avoidance. Seto et al. (1999) attested that incestuous biological fathers' phallometric arousal in response to pictures of children was higher compared to controls (non-offenders), equal to incestuous stepfathers, and lower compared to incestuous extended family members. Later on, this finding was replicated by Blanchard et al. (2006), again indicating that degree of pedophilic interest in paternal child sexual molesters lays in between the pedophilic interest of non-molesters and the pedophilic interest of non-paternal child sexual molesters. Thus, apparently, pedophilic interest does not need to be outspokenly large for spontaneous incest avoidance mechanisms to be overcome.

Despite these interesting investigations, little additional research has happened since. Nonetheless, more knowledge could still be obtained about, for instance, the potential interaction between pedophilic sexual interest and natural inbreeding avoidance mechanisms. At the very least, this research would focus on a broad range of close kin relations, include clinical and non-clinical subject samples and integrate different methodological approaches, the results ready to feed into programs that aim to prevent child maltreatment.

In part 2, we started with a critical analysis of the rational justifications for prohibiting or discouraging consensual sexual relationships between adult close kin, concluding that although such legal constraints are still widespread, these are built on shaky foundations (chapter 5). Moving away from societies' viewpoints, we zoomed in on moral psychological research about individual moral attitudes in chapter 6. Although moral judgments about incest have been used as a quintessential example of intuitive moral decision making (with a specific role for disgust), recent research increasingly highlights the impact of cognitive processes. Two explanatory models have been put forward to explain the structure of moral decision making about incest: the empathic disgust response hypothesis, which links individual moral judgments to personal sexual

aversions for incest (and cultural proscriptions), and the cultural psychological hypothesis, which exclusively links individual moral judgments to cultural proscriptions. According to the empathic disgust response hypothesis, people's negative moral judgments about consensual incest are driven by a personal reinterpretation of the act. Therefore, moral decisions reflect the feelings that are elicited when personally considering sexual behaviour with close kin. In chapter 7, we presented data indicating that implicit attitudes about incest (i.e., when people lack the time to consciously imagine incest) are less outspokenly negative than when assessing explicit, conscious, attitudes. As such, as we explained, these data concur with the empathic disgust response hypothesis. In the final chapter, we closed off with an exploration of explicit attitude change. It was shown that moral opposition against consensual incest decreases when people are provided with background information about the evolved origins of incest aversion and about the poor grounds on which current prohibitions against voluntary relations rest. This, we suggested, may have been in part due to a change in social expectancies about the categorical moral wrongness of incest. So, even though the aversive response to consensual sex between close kin will prove very hard to eliminate, as it is probably rooted in our evolved psychology in the form of personal sexual aversions, effective communication strategies might potentially lead to an increase in social acceptance.

Overall, what we eventually strive for, in modern-day society, is to guarantee sexual autonomy and freedom of partner choice as much as possible (see e.g. Article 8 of the European Convention on Human Rights). When it comes to 'incestuous behaviour', this means, on the one hand, protecting children and adults alike against within-family sexual abuse. On the other hand, it is equally important to grant people the right to choose adult close kin as sexual partners, as infrequent as it may be, and to strive for an increased social acceptance of such choice. Of course, this depends on reaching an agreement about the dubiousness of its explicit prohibition and its moral condemnation.

Bibliography

- Aberle, D.F., Bronfenbrenner, U., Hess, E.H., Miller, D.R., Schneider, D.M., & Spuhler, J.N. (1963). The incest taboo and mating patterns of animals. *American Anthropologist*, 65 (2), 253-265.
- Albrecht, H.J. & Sieber, U. (2007). Stellungnahme zu dem Fragenkatalog des Bundesverfassungsgerichts in dem Verfahren 2 BvR 392/07 zu § 173abs. 2S.2 StGB – Beischlaf zwischen geschwistern. https://www.mpicc.de/files/pdf1/05-08-inzest_gutachten3.pdf [10.2014].
- Anonymous (2006). Inbred obscurity: improving incest laws in the shadow of the ‘sexual family’. *Harvard Law Review*, 119, 2464-2485.
- Antfolk, J., Karlsson, M., Backstrom, A., & Santtila, P. (2012a) Disgust elicited by third-party incest: the roles of biological relatedness, coresidence, and family relationship. *Evolution and Human Behavior*, 33, 217-223.
- Antfolk, J., Lieberman, D., and Santtila, P. (2012b). Fitness costs predict inbreeding aversion irrespective of self-involvement: support for hypotheses derived from evolutionary theory, *PLoS ONE*, 7, e50613.
- Antfolk, J., Lindqvist, H., Albrecht, A., & Santtila, P. (2014). Self-reported availability of kinship cues during childhood is associated with kin-directed behavior to parents in adulthood. *Evolutionary Psychology*, 12 (1), 148-166.
- Aoki, K & Feldman, M.W. (1997). A gene-culture coevolutionary model for brother-sister mating. *Proceedings of the National Academy of Sciences of the United States of America*, 94 (24), 13046-13050.
- Banase, R. (1999). Automatic evaluation of self and significant others: affective priming in close relationships. *Journal of Social and Personal Relationships*, 16, 803-821.
- Banase, R. (2001). Affective priming with liked and disliked persons: prime visibility determines congruency and incongruency effects. *Cognition and Emotion*, 15, 501-520.
- Bateson, P. (1983). Optimal outbreeding. In Bateson, P. (Ed.). *Mate choice* (pp. 257-277). Cambridge, England: Cambridge University Press.
- Bateson, M., Nettle, D., & Roberts, G. (2006). Cues of being watched enhance cooperation in a real-world setting. *Biology letters*, 2, 412-414.
- Bauer, D.J., Preacher, K.J., Gil, K.M. (2006). Conceptualizing and testing random indirect effects and moderated mediation in multilevel models: New procedures and recommendations. *Psychological Methods*, 11 (2), 142-163.
- Bernat, E., Patrick, C.J., Benning, S.D., & Tellegen, A. (2006). Effects of picture content and intensity on affective physiological response. *Psychophysiology*, 43, 93-103.
- Bevc, I. & Silverman, I. (1993). Early proximity and intimacy between siblings and incestuous behavior. A test of the Westermarck theory. *Ethology and Sociobiology*, 14 (3), 171-181.
- Bevc, I. & Silverman, I. (2000). Early separation and sibling incest: a test of the revised Westermarck theory. *Evolution and Human Behavior*, 21 (3), 151-161.

- Bittles, A. H. (2004). Genetic aspects of inbreeding and incest. In Wolf, A.P., & Durham, W.H. (Eds.). *Inbreeding, incest and the incest taboo. The state of knowledge at the turn of the century*. Stanford: Stanford University Press.
- Blanchard, R., Kuban, M.E., Blak, T., Cantor, J.M., Klassen, P., & Dickey, R. (2006). Phallometric comparison of pedophilic interest in nonadmitting sexual offenders against stepdaughters, biological daughters, other biologically related girls, and unrelated girls. *Sexual abuse: a Journal of Research and Treatment*, 18 (1), 1-14.
- Blanton, H., Jaccard, J., Klick, J., Mellers, B., Mitchell, G., & Tetlock, P.E. (2009). Strong claims and weak evidence: reassessing the predictive validity of the IAT. *Journal of Applied Psychology*, 94, 3, 567-582.
- Bloch, Robert (1959) *Psycho*. New York: Simon & Schuster.
- Bluemke, M. & Friese, M. (2008). Reliability and validity of the single-target IAT (ST-IAT): assessing automatic affect towards multiple attitude objects. *European Journal of Social Psychology*, 38, 977-997.
- Borg, C., de Jong, P.J., & Schultz, W.W. (2010). Vaginismus and dyspareunia: automatic vs. deliberate disgust responsivity. *Journal of Sexual Medicine*, 7 (6), 2149-2157.
- Boyer, P. & Petersen, M.B. (2011). The naturalness of (many) social institutions: evolved cognition as their foundation. *Journal of Institutional Economics*, 8, 1-25.
- Bradley, M.M. & Lang, P.J. (1994). Measuring emotion: the self-assessment manikin and the semantic differential. *Journal of Behavior Therapy and Experimental Psychiatry*, 25 (1), 49-59.
- Bratt, C. S. (2004). Incest statutes and the fundamental right of marriage: is Oedipus free to marry? *Family Law Quarterly*, 18, 257-309.
- Bruce, V. & Valentine, T. (1986). Semantic priming of familiar faces. *The Quarterly Journal of Experimental Psychology Section A: Human Experimental Psychology*, 38 (1), 125-150.
- Burton, R.V. (1973). Folk theory and the incest taboo. *Ethos*, 1 (4), 504-516.
- Burton, A.M., Bruce, V., & Johnston, R.A. (1990). Understanding face recognition with an interactive activation model. *British Journal of Psychology*, 81, 361-380.
- Cacioppo, J. T., Berntson, G. G., Klein, D. J., & Poehlmann, K. M. (1997). The psychophysiology of emotion across the lifespan. *Annual Review of Gerontology and Geriatrics*, 17, 27-74.
- Cahill, C.M. (2000). What is our bane, that alone we have in common: incest, intimacy, and the crisis of naming. *Studies in Law, Politics and Society*, 21, 3-64.
- Cahn, N. (2009). Accidental incest: drawing the line – or the curtain? – for reproductive technology. *Harvard Journal of Law & Gender*, 32, 59-108.
- Cameron, C.D., Payne, B.K., & Knobe, J. (2010). Do theories of implicit race bias change moral judgments? *Social Justice Research*, 23, 272-289.
- Carsten, J. (1997). *The heat of the hearth: the process of kinship in a Malay fishing community*. Oxford: Clarendon Press.
- Cisler, J.M., Olatunji, B.O., & Lohr, J.M. (2009). Disgust, fear, and the anxiety disorders: a critical review. *Clinical Psychology Review*, 29, 34-46.
- Coats, E.J. & Feldman, R.S. (1996). Gender differences in nonverbal correlates of social status. *Personality and Social Psychology Bulletin*, 22 (10), 1014-1022.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Second ed. Hillsdale: NJ: Erlbaum.
- Cohn, J.F., Zlochower, A.J., Lien, J., & Kanade, T. (1999). Automated face analysis by feature point tracking has high concurrent validity with manual FACS coding. *Psychophysiology*, 36 (1), 35-43.
- Collins, J.M., Leib, E.J., & Marke, D. (2008). Punishing family status. *Boston University Law Review*, 88, 1327-1423.
- Cunningham, E., Forestell, C.A., & Dickter, C.L. (2013). Induced disgust affects implicit and explicit responses toward gay men and lesbians. *European Journal of Social Psychology*, 43, 362-369.

- Curry, O., Roberts, S.G.B., Dunbar, R.I.M. (2013). Altruism in social networks: evidence for a 'kinship premium'. *British Journal of Psychology*, 104, 283-295.
- Cushman, F.A., Young, L., & Greene, J. (2010). Multi-system moral psychology. In Doris, J.M., Harman, G., Nichols, S., Prinz, J., Sinnott-Armstrong, W., & Stich, S. (Eds.), *The Moral Psychology Handbook* (pp. 47-71). New York: Oxford University Press.
- Darwin, C. R. (1872). *The expression of the emotions in man and animals*. London: John Murray. 1st edition.
- Dasgupta, N., Greenwald, A.G., & Banaji, M.R. (2003). The first ontological challenge to the IAT: attitude or mere familiarity? *Psychological Inquiry*, 14 (3&4), 238-243.
- Dawson, M. E., Schell, A. M., & Filion, D. (2000). The electrodermal system. In Cacioppo, J., Tassinary, L.G., & Berntson, G.G. (Eds.), *Handbook of psychophysiology* (pp. 200-224). Cambridge, UK: Cambridge University Press.
- DBruine, L.M. (2005). Trustworthy but not lust-worthy: context-specific effects of facial resemblance. *Proceedings of the Royal Society B-Biological Sciences*, 272, 919-922.
- DeBruine, L.M., Jones, B.C., Watkins, C.D., Roberts, S.C., Little, A.C., Smith, F.G., & Quist, M.C. (2011). Opposite-sex siblings decrease attraction, but not prosocial attributions, to self-resembling opposite-sex faces. *Proceedings of the National Academy of Sciences of the United States of America*, 108 (28), 11710-11714.
- de Clercq, A., Verschuere, B., de Vlieger, P., & Crombez, G. (2006). Psychophysiological analysis (PSPHA): a modular script-based program for analyzing psychophysiological data. *Behavior Research Methods*, 38, 504-510.
- De Jong, P., van Overveld, M. and Peters, M.L. (2011). Sympathetic and parasympathetic responses to a core disgust video clip as a function of disgust propensity and disgust sensitivity. *Biological Psychology*, 88, 2-3, 174-179.
- De Smet, D., Van Speybroeck, L., & Verplaetse, J. (2014). The Westermarck effect revisited: a psychophysiological study of sibling incest aversion in young female adults *Evolution and Human Behavior*, 35, 34-42.
- Deutscher Ethikrat (2014). Inzestverbot. Stellungnahme. <http://www.ethikrat.org/dateien/pdf/stellungnahme-inzestverbot.pdf> [11.2014].
- Dimberg, U. (1990). Facial electromyography and emotional reactions. *Psychophysiology*, 27 (5), 481-494.
- Durham, W.H. (2004). Assessing the gaps in Westermarck's theory. In Wolf, P. & Durham, W.H. *Inbreeding, incest, and the incest taboo. The state of knowledge at the turn of the century* (pp. 121-138). Stanford: Stanford University Press.
- Durkheim, E. (1897). Prohibition de l'inceste et ses origines. *L'Année Sociologique*, 1, 1-70.
- Ebert, I.D., Steffens, M.C., Kroth, A. (2014). Warm, but maybe not so competent? – Contemporary implicit stereotypes of women and men in Germany. *Sex Roles*, 70, 359-375.
- Edwards, J. (2004). Incorporating incest: gamete, body and relation in assisted conception. *Journal of the Royal Anthropological Institute*, 10, 755-774.
- Ekman, P., & Friesen, W. V. (1975). *Unmasking the face*. Englewood Cliffs, NJ: PrenticeHall.
- Ekman, P. (1982). Methods for measuring facial action. In Scherer, K.R. & Ekman, P. (Eds.), *Handbook of methods in nonverbal behavior research* (pp. 45-135). New York: Cambridge University Press.
- Ekman P. & Keltner, D. (1997). Universal facial expressions of emotion: an old controversy and new findings. In Segerstrale U. & Molnar P. (Eds.), *Nonverbal communication: where nature meets culture* (pp. 27-46). Mahwah, NJ: Lawrence Erlbaum Associates.
- El Guindi, F. & al Othman, W. (2013). Transformationality and dynamicality of kinship structure. *Structure and Dynamics*, 6, 1-18.
- Epstein, S., Pacini, R., Denes-Raj, V. & Heier, H. (1996). Individual differences in intuitive-experiential and analytical-rational thinking styles. *Journal of Personality and Social Psychology*, 71 (2), 390-405.
- Farrelly, C. (2008). The case for re-thinking incest laws. *Journal of Medical Ethics*, 9, e11.

- Faul, F., Erdfelder, E., Lang, A.-G. & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, 39, 175-191.
- Faulkner, J., Schaller, M., Park, J.H., & Duncan, L.A. (2004). Evolved disease-avoidance mechanisms and contemporary xenophobic attitudes. *Group Processes and Intergroup Relations*, 7 (4), 333-353.
- Fessler, D.M.T. & Navarrete, C.D. (2004). Third-party attitudes toward sibling incest. Evidence for Westermarck's hypotheses. *Evolution and Human Behavior*, 25, 277-294.
- Fox, J.R. (1962). Sibling incest. *The British Journal of Sociology*, 13 (2), 128-150.
- Fox, R. (1967). *Kinship and marriage. An anthropological perspective* New York: Penguin Books.
- Fraley, R.C., & Marks, M.J. (2010). Westermarck, Freud, and the incest taboo: does familial resemblance activate sexual attraction? *Personality and Social Psychology Bulletin*, 36 (9), 1202-1212.
- Frank, D.J., Camp, B.J., & Boutcher, S.A. (2010). Worldwide trends in the criminal regulation of sex, 1945 to 2005. *American Sociological Review*, 75, 867-893.
- Frazer, J.G. (1910). *Totemism and exogamy*. 4 vol. London: Macmillan & Co.
- Frederick, S. (2005). Cognitive reflection and decision making. *Journal of Economic Perspectives*, 19, 24-42.
- Freud, S. (1913). *Totem und taboo*. Vienna: Hugo Heller.
- Fridlund, A.J. & Cacioppo, J.T. (1986). Guidelines for human electromyographic research. *Psychophysiology*, 23 (5), 567-589.
- Geer, J.H., & Robertson, G.G. (2005). Implicit attitudes in sexuality: gender differences. *Archives of Sexual Behavior*, 34 (6), 671-677.
- Greenwald, A.G. & Banaji, M.R. (1995). Implicit social cognition: attitudes, self-esteem, and stereotypes. *Psychological Review*, 102 (1), 4-27.
- Greenwald, A.G., McGhee, D.E., & Schwartz, J.L.K. (1998). Measuring individual differences in implicit cognition: the implicit association test. *Journal of Personality and Social Psychology*, 74 (6), 1464-1480.
- Greenwald, A.G., Nosek, B.A., & Banaji, M.R. (2003). Understanding and using the implicit association test: I. An improved scoring algorithm. *Journal of Personality and Social Psychology*, 85 (2), 197-216.
- Greenwald, A.G. & Krieger, L.H. (2006). Implicit bias: scientific foundations. *California Law Review*, 94 (4), 945-967.
- Greenwald, A.G., Poehlman, T.A., Uhlmann, E.L., & Banaji, M.R. (2009). Understanding and using the implicit association test: III. Meta-analysis of predictive validity. *Journal of Personality and Social Psychology*, 97 (1), 17-41.
- Gross, J.J. (1998). Antecedent- and response-focused emotion regulation: divergent consequences for experience, expression and physiology. *Journal of Personality and Social Psychology*, 74 (1), 224-237.
- Gutierrez, R. & Giner-Sorolla, R. (2007). Anger, disgust and presumption of harm as reactions to taboo-breaking behaviors. *Emotion*, 7, 853-868.
- Haig, D. (1999). Asymmetric relations: internal conflicts and the horror of incest. *Evolution and Human Behavior*, 20, 83-98.
- Haidt, J., Koller, S.H., & Dias, M.G. (1993). Affect, culture, and morality, or is it wrong to eat your dog? *Journal of Personality and Social Psychology*, 65, 4, 613-628.
- Haidt, J., McCauley, C., & Rozin, P. (1994). Individual differences in sensitivity to disgust: A scale sampling seven domains of disgust elicitors. *Personality and Individual Differences*, 16, 701-713.
- Haidt, J., Bjorklund, F., & Murphy, S. (2000) *Moral dumbfounding: When intuition finds no reason*. Unpublished manuscript, University of Virginia.
- Haidt, J. (2001). The emotional dog and its rational tail: a social intuitionist approach to moral judgment. *Psychological Review*, 108 (4), 814-834.

- Haidt, J. & Hersh, M.A. (2001). Sexual morality: the cultures and emotions of conservatives and liberals. *Journal of Applied Social Psychology*, 31, 191-221.
- Haig, D. (1999). Asymmetric relations: internal conflicts and the horror of incest. *Evolution and Human Behavior*, 20 (2), 83-98.
- Hamilton, W.D. (1963). The evolution of altruistic behavior. *The American Naturalist*, 97 (896), 354-356.
- Hayes, S. & Carpenter, B. (2012). Out of time: the moral temporality of sex, crime and taboo. *Critical Criminology*, 20, 141-152.
- Henn, W., Fonatsch, C., Haaf, T., Jung, C., Schwinger, E., Propping, P., Reis, A., Schröck, E., Weber, B., & Zühlke, C. (2008). Eugenische Argumentation im Beschluss des Bundesverfassungsgerichts zum Inzestverbot – Stellungnahme der deutschen Gesellschaft für Humangenetik. *Medizinische Genetik*, 20, 239.
- Hoben, A.D., Buunk, A.P., Fincher, C.L., Thornhill, R., & Schaller, M. (2010). On the adaptive origins and maladaptive consequences of human inbreeding: parasite prevalence, immune functioning, and consanguineous marriage. *Evolutionary Psychology*, 8 (4), 658-676.
- Home Office (2000). *Setting the Boundaries: Reforming the Law on Sex Offences*. London, UK: Home Office Communication Department.
- Inbar, Y., Pizarro, D.A., Knobe, J., & Bloom, P. (2009). Disgust sensitivity predicts intuitive disapproval of gays. *Emotion*, 9 (3), 435-439.
- Inbar, Y., Pizarro, D.A., & Bloom, P. (2012). Disgusting smells cause decreased liking of gay men. *Emotion*, 12 (1), 23-27.
- Johnston, R.A. & Barry, C. (2006). Repetition priming of access to biographical information from faces. *Quarterly Journal of Experimental Psychology*, 59 (2), 326-339.
- Karpinski, A. & Steinman, R.B. (2006). The single category implicit association test as a measure of implicit social cognition. *Journal of Personality and Social Psychology*, 91 (1), 16-32.
- Kass, L. (1997). The wisdom of repugnance. *New Republic*, 216, 17-26.
- Kassam, K.S. & Mendes, W.B. (2013). The effects of measuring emotion: physiological reactions to emotional situations depend on whether someone is asking. *PLoS ONE*, 8 (6), e64959.
- Kelly, D. (2011). *Yuck! The nature and moral significance of disgust*. Cambridge: The MIT Press.
- Kohlberg, L. (1969). Stage and sequence: The cognitive-developmental approach to socialization. In Goslin, D.A. (Ed.), *Handbook of socialization theory and research* Chicago: Rand McNally.
- Korb, S., With, S., Niedenthal, P., Kaiser, S., Grandjean, D. (2014). The perception and mimicry of facial movements predict judgments of smile authenticity. *PloS ONE*, 9 (6), e99194.
- Korchmaros, J.D. & Kenny, D.A. (2001). Emotional closeness as a mediator of the effect of genetic relatedness on altruism. *Psychological Science*, 12 (3), 262-265.
- Kouider, S. & Dehaene, S. (2007). Levels of processing during non-conscious perception: a critical review of visual masking. *Philosophical Transactions of the Royal Society B – Biological Sciences*, 362 (1481), 857-875.
- Koukounas, E. and Over, R. (1997). Male sexual arousal elicited by film and fantasy matched in content, *Australian Journal of Psychology*, 49, 1, 1-5.
- Kushnick, G., & Fessler, D.M.T. (2011). Karo Batak Cousin Marriage, cosocialization and the Westermarck hypothesis. *Current Anthropology*, 52 (3), 443-448.
- Lai, C.K., Haidt, J., & Nosek, B.A. (2014). Moral elevation reduces prejudice against gay men. *Cognition and Emotion*, 28 (5), 781-794.
- Lane, K.A., Banaji, M.R., Nosek, B.A., & Greenwald, A.G. (2007). Understanding and using the implicit association test: IV. What we know (so far). In Wittenbrinck, B. & Schwartz, N.S. (Eds.), *Implicit measures of attitudes: procedures and controversies*. (pp. 59-102). New York: Guilford Press.
- Lang, A. & Atkinson, J.J. (1903). *Social origins. Primal Law*. London: Longmans, Green and Co.

- Lang, P. J. (1980). Behavioral treatment and bio-behavioral assessment: computer applications. In J. B. Sidowski, J. H. Johnson, & T. A. Williams (Eds.), *Technology in mental health care delivery systems* (pp. 119-137). Norwood, NJ: Ablex.
- Lang, P.J., Greenwald, M.K., Bradley, M.M., & Hamm, A.O. (1993). Looking at pictures – affective, facial, visceral, and behavioral reactions. *Psychophysiology*, 30, 261-273.
- Lang, P.J., Bradley, M.M., & Cuthbert, B.N. (2005). *International affective picture system (IAPS): Affective ratings of pictures and instruction manual*. Technical Report A-6. University of Florida, Gainesville, FL.
- Leavitt, G.C. (2013). Tylor vs. Westermarck: explaining the incest taboo. *Sociology Mind*, 3 (1), 45-51.
- Lee, T.R., Mancini, J.A., & Maxwell, J.W. (1990). Sibling relationships in adulthood – contact patterns and motivations. *Journal of Marriage and the Family*, 52 (2), 431-440.
- Leeming, W. (1996). New taboo? Some observations on the late arrival of changes to the law of incest in Scotland. *International Journal of the Sociology of Law*, 24, 313-336.
- Levenson, R.W., Ekman, P., & Friesen, W.V. (1990). Voluntary facial action generates emotion-specific autonomous nervous system activity. *Psychophysiology*, 27 (4), 363-384.
- Lévi Strauss, Claude (1948). *Les structures élémentaires de la parenté*. Paris: Mouton.
- Lewis, David M.G. (2011). The sibling uncertainty hypothesis: facial resemblance as a sibling recognition cue. *Personality and Individual Differences*, 51, 969-974.
- Lieberman, D., Tooby, J., & Cosmides, L. (2003). Does morality have a biological basis? An empirical test of the factors governing moral sentiments regarding incest. *Proceedings of the Royal Society B*, 270, 819-826.
- Lieberman, D., Tooby, J., & Cosmides, L. (2007). The architecture of human kin detection. *Nature*, 445, 727-731.
- Lieberman, D., Oum, R., & Kurzban, R. (2008). The family of fundamental social categories includes kinship: evidence from the memory confusion paradigm. *European Journal of Social Psychology*, 38 (6), 998-1012.
- Lieberman, D. (2009). Rethinking the Taiwanese marriage data: evidence the mind uses multiple kinship cues to regulate inbreeding avoidance. *Evolution and Human Behavior*, 30, 153-160.
- Lieberman, D., Fessler, D.M.T., & Smith, A. (2011). The relationship between familiar resemblance and sexual attraction: an update on Westermarck, Freud, and the incest taboo. *Personality and Social Psychology Bulletin*, 37 (9), 1229-1232.
- Lieberman, D., & Lobel, T. (2012). Kinship on the Kibbutz: coresidence duration predicts altruism, personal sexual aversions and moral attitudes among communally reared peers. *Evolution and Human Behavior*, 33, 26-34.
- Lieberman, D., & Smith, A. (2012). It's all relative: sexual aversions and moral judgments regarding sex among siblings. *Current Directions in Psychological Science*, 21, 243-247.
- Lundqvist, L.O. & Dimberg, U. (1995). Facial expressions are contagious. *Journal of Psychophysiology*, 9 (3), 203-211.
- Luo, L. (2011). Is there a sensitive period in human incest avoidance? *Evolutionary Psychology*, 9 (2), 285-295.
- MacInnis, C.C. & Hodson, G. (2013). Is homophobia associated with an implicit same-sex attraction? *Journal of Sex Research*, 50 (8), 777-785.
- Malinowski, B. (1927). *Sex and repression in savage society*. London: Routledge & Kegan Paul.
- Marcinkowska, U.M., Moore, F.R., & Rantala, M.J. (2013). An experimental test of the Westermarck effect: sex differences in inbreeding avoidance. *Behavioral Ecology*, 24 (4), 842-845.
- Marquardt, N. & Hoeger, R. (2009). The effect of implicit moral attitudes on managerial decision-making: an implicit social cognition approach. *Journal of Business Ethics*, 85, 157-171.
- McAlister, R.W., Harkness, E.M., & Nicoll, J.J. (1998). An ultrasound investigation of the lip levator musculature. *European Journal of Orthodontics*, 20 (6), 713-720.

- McCabe, J. (1983). FBD marriage: further support for the Westermarck hypothesis of the incest taboo, *American Anthropologist*, 85, 50-69.
- McDonnell, B. (2004). Is incest next? *Cardozo Women's Law Journal*, 10, 337-364.
- Morgan, L.H. (1877). *Ancient Society*. London: Macmillan & Co.
- Navarrete, C.D. & Fessler, D.M.T. (2006). Disease avoidance and ethnocentrism: the effects of disease vulnerability and disgust sensitivity on intergroup attitudes. *Evolution and Human Behavior*, 27, 270-282.
- Neumann, R. & Lozo, L. (2012). Priming the activation of fear and disgust: evidence for semantic processing. *Emotion*, 12 (2), 223-228.
- Nosek, B.A., Greenwald, A.G., & Banaji, M.R. (2007). The implicit association test at age 7: a methodological and conceptual review. In Bargh, J.A. (Ed.), *Social Psychology and the Unconscious: The Automaticity of Higher Mental Processes* (pp. 265-292). New York: Psychology Press.
- Nussbaum, M. (2004) *Hiding from humanity: disgust, shame and the law*. Princeton University Press, Princeton.
- Olatunji, B.O., Williams, N.L., Tolin, D.F., Sawchuck, C.N., Abramowitz, J.S., Lohr, J.M., & Elwood, L. S. (2007). The disgust scale: Item analysis, factor structure, and suggestions for refinement. *Psychological Assessment*, 19, 281-297.
- Olatunji, B. (2008). Disgust, scrupulosity and conservative attitudes about sex: evidence for a mediational model of homophobia; *Journal of Research in Personality*, 42, 1364-1369.
- Parker, S. (1976). The pre-cultural basis of the incest taboo: toward a biosocial theory. *American Anthropologist*, 78 (2), 285-305.
- Parker, H. & Parker, S. (1986). Father-daughter sexual abuse – an emerging perspective. *American Journal of Orthopsychiatry*, 56 (4), 531-549.
- Parker, S. (1987). The waning of the incest taboo. *Legal Studies Forum*, 6, 205-222.
- Pennings, G. (2002). Incest, gamete donation by siblings and the importance of the genetic link. *Reproductive Biomedicine Online*, 4, 13-15.
- Piaget, J. (1965). *The moral judgment of the child*. New York: Free Press.
- Piazza, J., Russell, P.S. & Sousa, P. (2013)/ Moral emotions and the envisaging of mitigating circumstances for wrongdoing. *Cognition and Emotion*, 27, 707-722.
- Plakias, A. (2013). The good and the gross. *Ethical Theory and Moral Practice*, 16, 261-278.
- Pollet, T.V. (2007). Genetic relatedness and sibling relationship characteristics in a modern society. *Evolution and Human Behavior*, 28, 176-185.
- Pollet, T.V., Roberts, S.G.B. & Dunbar, R.I.M. (2013). Going that extra mile: individuals travel further to maintain face-to-face contact with highly related kin than with less related kin. *PLoS ONE*, 8 (1), e53929.
- Prokasy, W.F., & Raskin, D.C. (Eds.). (1973). *Electrodermal activity in psychological research*. New York, NY: Academic Press.
- Pusey, A. & Wolf, M. (1996). Inbreeding avoidance in animals. *Trends in Ecology & Evolution*, 11 (5), 201-206.
- Pusey, A. (2004). Inbreeding avoidance in primates. In Wolf, P. & Durham, W.H. *Inbreeding, incest, and the incest taboo. The state of knowledge at the turn of the century* (pp. 61-75). Stanford: Stanford University Press.
- Quintelier, K., De Smet, D., & Fessler, D.M.T. (2014). Agent versus appraiser moral relativism: an exploratory study. In Wright, J. & Sarkissian, H. (Eds.), *Advances in experimental moral philosophy*, London: Bloomsbury.
- Reynaud, E., El-Khoury-Malhame, M., Blin, O., & Khalfa, S. (2012). Voluntary emotional suppression modifies psychophysiological responses to films. *Journal of Psychophysiology*, 26 (3), 116-123.
- Roffee, J.A. (2014). The synthetic necessary truth behind new labour's criminalisation of incest. *Social and Legal Studies*, 23 (1), 113-130.

- Rohrmann, S., & Hopp, H. (2008). Cardiovascular indicators of disgust. *International Journal of Psychophysiology*, 68, 201-208.
- Rohrmann, S., Hopp, H., & Quirin, M. (2008). Gender differences in Psychophysiological responses to disgust. *Journal of Psychophysiology*, 22, 65-75.
- Rohrmann, S. Hopp, H. Schienle, A., & Hodapp, V. (2009). Emotion regulation, disgust sensitivity, and psychophysiological responses to a disgust-inducing film. *Anxiety, Stress & Coping*, 22, 215-236.
- Royzman, E. B., Leeman, R. F., & Sabini, J. (2008). "You make me sick": Moral dyspepsia as a reaction to third-party sibling incest. *Motivation and Emotion*, 32, 100-108.
- Royzman, E.B., Leeman, R.F., & Baron, J. (2009). Unsentimental ethics: towards a content-specific account of the moral-conventional distinction. *Cognition*, 112, 159-174.
- Royzman, E., Atanasov, P., Landy, J.F., Parks, A., & Gepty, A. (2014a). CAD or MAD? Anger (not disgust) as the predominant response to pathogen-free violations of the divinity code. *Emotion*, 14 (5), 892-907.
- Royzman, E., Landy, J.F., & Goodwin, G.P. (2014b). Are good reasoners more incest-friendly? Trait cognitive reflection predicts selective moralization in a sample of American students. *Judgment and Decision Making*, 9 (3), 176-190.
- Rozin, P., Haidt, J., McCauley, C.R. (1999a). Disgust: the body and soul emotion. In Dalglish, T., & Power, M. (Eds.), *Handbook of Cognition and Emotion* (pp. 429-445). Cichester: John Wiley & Sons.
- Rozin, P., Lowery, L., Imada, S., & Haidt, J. (1999b). The CAD triad hypothesis: a mapping between three moral emotions (contempt, anger and disgust) and three moral codes (community, autonomy, divinity). *Journal of Personality and Social Psychology*, 76 (4), 574-586.
- Rozin, P., Haidt, J., & McCauley, C.R. (2000). Disgust. In Lewis, M. & Haviland-Jones, J.M. (Eds.), *Handbook of emotions*, 2nd edition, (pp. 637-653). New York: Guilford Press.
- Rozin, P., Haidt, J., & McCauley, C.R. (2008). Disgust. In Lewis, M., Haviland-Jones, J.M., & Barrett, L.F. (Eds.), *Handbook of emotions*, 3rd edition, (pp. 757-776). New York: Guilford Press.
- Schachter, S. & Singer, J.E. (1962). Cognitive, social and physiological determinants of emotional state. *Psychological Review*, 69 (5), 379-399.
- Schaich Borg, J., Lieberman, D., & Kiehl, K.A. (2008). Infection, incest, and iniquity: investigating the neural correlates of disgust and morality. *Journal of Cognitive Neuroscience*, 20 (9), 1529-1546.
- Schaller, M., Miller, G.E., Gervais, W.M., Yager, S., & Chen, E. (2010). Mere visual perception of other people's disease symptoms facilitates a more aggressive immune response. *Psychological Science*, 21 (5), 649-652.
- Scheufele, D.A. (2014). Science communication as political communication. *Proceedings of the National Academy of Sciences in the United States of America*, 111, 13585-13592.
- Schienle, A., Stark, R., & Vaitl, D. (2001). Evaluative conditioning: a possible explanation for the acquisition of disgust responses? *Learning and Motivation*, 32, 65-83.
- Schienle, A., Walter, B., Stark, R., & Vaitl, D. (2002). Ein Fragebogen zur Erfassung der Ekelempfindlichkeit. *Zeitschrift für Klinische Psychologie und Psychotherapie*, 31, 110-120.
- Schmidt, K.L. & Cohn, J.F. (2001). Human facial expressions as adaptations: evolutionary questions in facial expression research. *Yearbook of Physical Anthropology*, 44, 3-24.
- Scolnick, A.J., Bascom, K.L., & Wilson, D.T. (2013). Gender role expectations of disgust: men are low and women are high. *Sex Roles*, 69, 72-88.
- Scottish Law Commission (1980). Memorandum No: 44, The Law of Incest in Scotland (April 1980). H.M.S.O.: Edinburgh.
- Scottish Law Commission (1981). The Law of Incest in Scotland: Report on a Reference Under Section 3(1)(e) of the Law Commissions Act 1965, Cmnd. 8422 (December 1981). H.M.S.O.: Edinburgh.

- Sesardic, N. (2004). From genes to incest taboos. The crucial step. In Wolf, P. & Durham, W.H. Inbreeding, incest, and the incest taboo. The state of knowledge at the turn of the century (pp. 109-120). Stanford: Stanford University Press.
- Seto, M.C., Lalumiere, M.L., & Kuban, M. (1999). The sexual preferences of incest offenders. *Journal of Abnormal Psychology*, 108 (2), 267-272.
- Shenhav, A., & Mendes, W.B. (2014). Aiming for the stomach and hitting the heart: dissociable triggers and sources for disgust reactions. *Emotion*, 14 (2), 301-309.
- Shepher, J. (1971). Mate selection among second generation Kibbutz adolescents and adults: incest avoidance and negative imprinting. *Archives of Sexual Behaviour*, 1, 293-307.
- Shor, E., & Simchai, D. (2009). Incest Avoidance, the Incest Taboo, and Social Cohesion: Revisiting Westermarck and the Case of the Israeli Kibbutzim. *American Journal of Sociology*, 114, 1803-1842.
- Shweder, R. A., Much, N. C., Mahapatra, M., & Park, L. (1997). The “big three” of morality (autonomy, community, and divinity), and the “big three” explanations of suffering. In A. Brandt & P. Rozin (Eds.), *Morality and health* (pp. 119-169). New York, NY: Routledge.
- Silverman, I. & Bevc, I. (2005). Evolutionary origins and ontogenetic development of incest avoidance. In Ellis, B.J. & Bjorklund, D.F. (Eds.), *Origins of the social mind. Evolutionary psychology and child development*. New York: The Guilford Press.
- Smith, C.T. & Nosek, B.A. (2011). Affective focus increases the concordance between implicit and explicit attitudes. *Social Psychology*, 42 (4), 300-313.
- Stark, R., Schienle, A., & Vaitl, D. (1998). Looking at pictures: disgust is mirrored by facial EMG. *International Journal of Psychophysiology*, 30 (1-2), 104-105.
- Stark, R., Walter, B., Schienle, A., & Vaitl, D. (2005). Psychophysiological correlates of disgust and disgust sensitivity. *Psychophysiology*, 19, 50-60.
- Süsskind, J.M., Lee, D.H., Cusi, A., Feiman, R., Grabski, W., & Anderson, A.K. (2008). Expressing fear enhances sensory acquisition. *Nature Neuroscience*, 11 (7), 843-850.
- Tassinari, L.G., Cacioppo, J.T., & Vanman, E.J. (2000). The skeletomotor system: surface electromyography. In; Cacioppo, J.T., Tassinari, L.G., & Berntson, G.G. (Eds.), *Handbook of psychophysiology* (2nd ed.), (pp. 163-199). New York, NY: Cambridge University Press.
- Thomas, A., Vaughn, E.D., Doyle, A., & Bubbs, R. (2014). Implicit association tests of attitudes toward persons with disabilities. *Journal of Experimental Education*, 82 (2), 184-204.
- Thompson, A.E., O’Sullivan, L.F., Byers, E.S., & Shaughnessy, K. (2014). Young adults’ implicit and explicit attitudes towards the sexuality of older adults. *Canadian Journal on Ageing*, 33 (3), 259-270.
- Tooby, J. & Cosmides, L. (1992). The psychological foundations of culture. In Barkow, J., Cosmides, L., & Tooby, J. (Eds.), *The adapted mind: evolutionary psychology and the generation of culture* (pp. 19-136). New York: Oxford University Press.
- Tooby, J., Cosmides, L., Sell, A., Lieberman, D., Sznycer, D. (2008). Internal regulatory variables and the design of human motivation: a computational and evolutionary approach. In Elliot, A. (Ed.), *Handbook of Approach and Avoidance Motivation*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Treas, J., Lui, J., & Gubernskaya, Z. (2014). Attitudes on marriage and new relationships: cross-national evidence on the deinstitutionalization of marriage. *Demographic Research*, 30, 1495-1525.
- Trivers, R.L. (1972). Parental investment and sexual selection. In Campbell, B. (Ed.), *Sexual selection and the descent of man 1871-1971* (pp. 136-179). Chicago: Aldine.
- Turiel, E. (1983). *The development of social knowledge: morality and convention* Cambridge, England: Cambridge University Press.

- Turiel, E., Hildebrandt, C., & Wainryb, C. (1991). Judging social issues: difficulties, inconsistencies, and consistencies. *Monographs of the Society for Research in Child Development*, 56, 1-103.
- Turner, J. & Maryanski, A. (2005). *Incest. Origins of the taboo*. Boulder: Paradigm Publishers.
- Tybur, J.M., Lieberman, D., & Griskevicius, V. (2009). Microbes, mating and morality: individual differences in three functional domains of disgust. *Journal of Personality and Social Psychology*, 97 (1), 103-122.
- Tybur, J.M., Bryan, A.D., Lieberman, D., Hooper, A.E.C., & Merriman, L.A. (2011). Sex differences and sex similarities in disgust sensitivity. *Personality and Individual Differences*, 51 (3), 343-348.
- Tybur, J.M. & Griskevicius, V. (2013). Evolutionary Psychology: a fresh perspective for understanding and changing problematic behavior. *Public Administration Review*, 73 (1), 12-22.
- Van den Berghe, P. (1980). Incest and exogamy: a sociobiological reconsideration. *Ethology and Sociobiology*, 1 (2), 151-162.
- Venables, P.H., & Mitchell, D.A. (1996). The effects of age, sex, and time of testing on skin conductance activity. *Biological Psychology*, 43, 87-101.
- Vrana, S.R. (1993). The psychophysiology of disgust: Differentiating negative emotional contexts with facial EMG. *Psychophysiology*, 30, 279-286.
- Voutilainen, L., Henttonen, P., Kahri, M., Kivioja, M., Ravaja, N., Sams, M., & Peräkylä, A. (2014). Affective stance, ambivalence, and psychophysiological responses during conversational storytelling. *Journal of Pragmatics*, 68, 1-24.
- Wagenbreth, C., Rieger, J., Heinze, H., & Zaehle, T. (2014). Seeing emotions in the eyes – inverse priming effects induced by eyes expressing mental states. *Frontiers in Psychology*, 5, article number 1039.
- Walter, A. (1997). The evolutionary psychology of mate selection in Morocco – a multivariate analysis. *Human Nature – an interdisciplinary biosocial perspective*, 8, 113-137.
- Walter, A. & Buyske, S. (2003). The Westermarck effect and early childhood co-socialization: sex differences in inbreeding avoidance. *British Journal of developmental psychology*, 21, 353-365.
- Weisfeld, G.E., Czilli, T., Phillips, K.A., Gall, J.A., & Lichtman, C.M. (2003). Possible olfaction-based mechanisms in human kin recognition and inbreeding avoidance. *Journal of Experimental Child Psychology*, 85, 279-295.
- Westermarck, E. A. (1891). *The history of human marriage*. London: Macmillan & co.
- Westermarck, E. A. (1908). *The origin and development of moral ideas Vol. 2*. London: Macmillan & co.
- Westermarck, E. A. (1917). *The origin and development of moral ideas Vol. 2*. 2nd Ed. London: Macmillan & co.
- Westermarck, E. A. (1922). *The history of human marriage. Vol. 2*. 5th Ed. New York: Allerton Book Co.
- Westermarck, E.A. (1934). Recent theories of exogamy. *Sociological Review*, 26, 22-40.
- Wheatley, T. & Haidt, J. (2005). Hypnotic disgust makes moral judgments more severe. *Psychological Science*, 16, 780-785.
- White, L. (1948). The definition and prohibition of incest. *American Anthropologist*, 50, 416-435.
- Wiese, H. (2011). The structure of semantic person memory: evidence from semantic priming in person recognition. *British Journal of Psychology*, 102, 899-914.
- Williams, L.M., & Finkelhor, D. (1995). Paternal caregiving and incest – test of a biosocial model. *American Journal of Orthopsychiatry*, 65 (1), 101-113.
- Wigboldus, D. H. J., Holland, R. W., & van Knippenberg, A. (2004). Single target implicit associations. Unpublished manuscript.
- Wolf, A.P. (1995). *Sexual Attraction and Childhood Association. A Chinese Brief for Edward Westermarck*. California: Stanford University Press.

- Wolf, A.P. (2004). Explaining the Westermarck-effect. Or, what did natural selection select for? In Wolf, A.P. & Durham, W.H. (Eds.), *Inbreeding, incest, and the incest taboo. The state of knowledge at the turn of the century* (pp. 76-92). Stanford: Stanford University Press.
- Wolf, A.P. & Durham, W.H. (2004). *Inbreeding, incest, and the incest taboo. The state of knowledge at the turn of the century*. Stanford: Stanford University Press.
- Yartz, A.R. & Hawk, L.W. (2002). Addressing the specificity of affective startle modulation: fear versus disgust. *Biological Psychology*, 59 (1), 55-68.
- Young, L. & Saxe, R. (2011) When ignorance is no excuse: different roles for intent across moral domains. *Cognition*, 120, 202-214.

Appendix

Appendix 1 – Overview of the Dutch stimuli words, along with their English translations.

Experimental condition	Specific Word/Image Category Combination	
	Prime Word	Image Stimuli
Family (40 trials)	Brother ('broer') Sister ('zus') Mother ('moeder') Father ('vader') Uncle ('oom') Aunt ('tante') Grandmother ('oma') Grandfather ('opa') Cousin (male) ('neef') Cousin (female) ('nicht')	Neutral Pathogen Heterosex Homosex
Non-Family (40 trials)	Teacher ('leraar') Student ('student') Neighbor (f) ('buurvrouw') Neighbor (m) ('buurman') Boss ('baas') Colleague ('collega') Physician ('huisarts') Hairdresser ('kapper') Mailman ('postbode') Dentist ('tandarts')	Neutral Pathogen Heterosex Homosex

Appendix 2 – Results of the pre-test : prime stimuli (words)

Participants

Thirty subjects (age $MEAN \pm SD = 43.53 \pm 12.24$, age range 23-69, 37% females) participated in the pre-test. Subjects were recruited online through the web-based crowdsourcing device Crowdfunder. All data were collected online, and a small monetary compensation (approximately 1 euro) was paid to each participant after full completion of the task. Only people based in Belgium or the Netherlands could participate, and all subjects reported to have either the Belgian (17%) or Dutch nationality.

Materials

Words – 34 words were included in the pre-test, 16 referred to a person who is a family member, and 18 referred to a person who is not a family member. An overview is provided in table 2A.

Table 2A. Overview of the Dutch words included in the pre-test, along with their English translations

Words referring to family members	grandparents ('grootouders'), father ('vader'), male cousin ('neef'), mother ('moeder'), female cousin ('nicht'), mother synonym ('mama'), aunt ('tante'), father synonym ('papa'), grandmother ('grootmoeder'), parents ('ouders'), grandmother synonym ('oma'), brother ('broer'), grandfather ('grootvader'), sister ('zus'), uncle ('oom'), grandfather synonym ('opa').
Words not referring to family members	Teacher ('leraar'), librarian ('bibliotheekbediende'), hairdresser ('kapper'), professor ('professor'), colleague ('collega'), mailman ('postbode'), male friend ('vriend'), dentist ('tandarts'), female friend ('vriendin'), banker ('bankier'), acquaintance ('kennis'), student ('student'), male neighbor ('buurman'), mayor ('burgemeester'), physician ('huisarts'), female neighbor ('buurvrouw'), partner ('partner'), boss ('baas').

Evaluative self-report measures – Subjects assigned to each of the words in the pre-test a score on the following three questions: (1) 'How close is this person to you in terms of family relatedness?' (Likert-scale: 1= not at all close; 7= very close), (2) 'How positive or negative is this person to you?' (Likert-scale: 1= very negative; 7= very positive), (3) 'How difficult or easy is it for you to imagine this person?' (Likert-scale: 1= very difficult; 7= very easy).

Procedure

For each question, stimuli words were listed on the computer screen, one underneath the other. First, all words were rated on the first question, then the second, and ending with the third. After approximately 20 minutes the test was finished and subjects were paid online.

Results

Mean values and standard deviations for each of the words presented in the pre-test are summarized below. Words not retained in the final sample are shaded. For both categories (family and not family), 10 words needed to be retained in the final sample.

In the family category, all word stimuli scored high on kinship, valence and imaginable. Family words were eliminated either because they were redundant (e.g. 'mama' being a synonym for 'moeder'), or because they represented multiple people instead of one (e.g. parents), or because of slightly larger number of characters compared to the other stimuli (e.g. 'grootmoeder', 'grootvader').

In the non-family category, scores on kinship, valence and imaginable had larger variances. Non-family words were eliminated either because of scoring higher than the others on kinship (e.g. partner, acquaintance, female friend and male friend), because of scoring relatively lower than the others on valence or imaginable (e.g. mailman, banker), or because of slightly larger number of characters compared to the other stimuli (e.g. 'burgemeester', 'bibliotheekbediende').

Looking at the mean scores of the final selection of word primes (i.e. in the table below, all words except those in shades), 'kinship' evaluations were significantly higher in the family category ($MEAN \pm SD = 5.92 \pm .98$) than in the non-family category ($MEAN \pm SD = 2.21 \pm 1.11$), which was what we aimed for (paired samples t-test: $t(29) = 11.92$, $p = .000$). However, family words also scored significantly higher on valence ($MEAN \pm SD = 6.02 \pm .96$) than the words not referring to family ($MEAN \pm SD = 4.05 \pm 1.04$) (paired samples t-test: $t(29) = 9.95$, $p = .000$). While words that referred to family were on average evaluated as positive, the words not referring to family were rather evaluated as neutral. Also, family words scored significantly higher on imaginable ($MEAN \pm SD = 6.00 \pm 1.22$) than the words not referring to family ($MEAN \pm SD = 4.72 \pm 1.16$) (paired samples t-test: $t(29) = 4.95$, $p = .000$).

	Kinship		Valence		Imaginable	
	MEAN	SD	MEAN	SD	MEAN	SD
Family						
Grandparents ('Grootouders')	6.00	1.26	6.33	1.18	6.00	1.53
Father ('Vader')	6.33	1.37	6.27	1.28	6.17	1.51
Male cousin ('Neef')	5.00	1.14	5.23	1.10	5.50	1.33
Mother ('Moeder')	6.57	.97	6.57	.94	6.57	1.04
Female cousin ('Nicht')	5.30	1.34	5.67	1.12	5.63	1.62
Mother synonym ('Mama')	6.37	1.03	6.43	.97	6.60	.93
Aunt ('Tante')	5.37	1.22	5.90	1.16	5.70	1.57
Father synonym ('Papa')	6.37	1.07	6.23	1.28	6.20	1.49
Grandmother ('Grootmoeder')	5.93	1.31	6.23	1.30	6.17	1.46
Parents ('Ouders')	6.63	.93	6.53	.94	6.40	1.33
Grandmother synonym ('Oma')	6.17	1.21	6.23	1.17	6.17	1.46
Brother ('Broer')	6.27	1.17	6.07	1.17	5.90	1.75
Grandfather ('Grootvader')	5.97	1.43	6.00	1.39	6.03	1.52
Sister ('Zus')	6.53	.94	6.30	1.06	6.30	1.29
Uncle ('Oom')	5.63	1.16	5.93	1.17	5.97	1.47
Grandfather Synonym ('Opa')	6.00	1.44	6.07	1.31	6.10	1.56
Not family						
Teacher ('Leraar')	2.70	1.49	4.43	1.38	4.83	1.53
Librarian ('Bibliotheekbediende')	1.57	.97	3.73	1.01	3.33	1.45
Hairdresser ('Kapper')	1.73	1.23	3.83	1.09	4.17	1.49
Professor ('Professor')	1.93	1.08	3.87	1.07	4.13	1.28
Colleague ('Collega')	2.83	1.29	4.27	1.36	5.20	1.58
Mailman ('Postbode')	1.67	.99	3.73	1.26	3.97	1.56
Male friend ('Vriend')	4.47	1.53	5.63	1.00	5.83	1.26
Dentist ('Tandarts')	1.87	1.17	4.00	1.62	4.93	1.72
Female friend ('Vriendin')	5.33	1.42	6.10	.99	6.17	1.42
Banker ('Bankier')	1.60	.97	2.87	1.46	2.90	1.69
Acquaintance ('Kennis')	3.03	1.38	4.53	.97	5.13	1.22
Student ('Student')	2.17	1.32	3.77	1.10	4.33	1.21
Male neighbour ('Buurman')	2.77	1.57	4.30	1.06	5.50	1.33
Mayor ('Burgemeester')	1.47	1.04	3.60	1.30	3.23	1.43
Physician ('Huisarts')	2.37	1.43	4.30	1.37	5.07	1.57
Female neighbour ('Buurvrouw')	2.63	1.54	4.47	1.14	5.13	1.57
Partner ('Partner')	6.40	1.13	6.43	1.14	6.17	1.56
Boss ('Baas')	2.13	1.22	4.00	1.46	4.80	1.49

Appendix 3 – Results of the pre-test : target stimuli (images)

Participants

Sixty subjects (age $MEAN \pm SD = 44.52 \pm 11.77$, age range 23-69, 40% females) participated in the pre-test. Subjects were recruited online through the web-based crowdsourcing device Crowdfunder. All data were collected online, and a small monetary compensation (approximately 1 euro) was paid to each participant after full completion of the task. Only people based in Belgium or the Netherlands could participate, and all subjects reported to have either the Belgian (22%) or Dutch nationality.

Materials

Images – Images depicted either a pathogen cue (PATHOGEN), a sexual activity between a man and a woman (HETERO), a sexual activity between two men (HOMO) or a non-sexual and non-pathogen related neutral stimulus (NEUTRAL). Part of the images included in the pre-test had been used already in previous experiments (see chapters 2 and 3). An internet-based search increased this image sample to a total of 100 (i.e. 25 pictures for each category). Pathogen images depicted close-ups of stimuli high in pathogen presence (e.g., feces, meat containing maggots, infected human eyes, dirty teeth, etc.). Each heterosexual sex image depicted a man and a woman involved in an intimate/sexual act (e.g. kissing on the mouth, oral sex, sexual intercourse, etc.). Homosexual sex images depicted the same acts, involving two men. Most of the hetero and homo pictures displayed two naked individuals. Images were specifically selected for their ‘non-pornographic’ character, i.e. both individuals were fully visible on the picture, without any close-ups of genitals or display of bodily fluids. Neutral images either depicted nature landscapes (e.g., a flower field), non-predatory animals (e.g. a cat), baby’s, healthy looking food or people performing a leisure activity (e.g. swimming).

Evaluative self-report measures –As self-report measures, we used the self-assessment manikin (SAM) scales for valence, arousal and dominance (see figures 3A, 3B and 3C below) (Lang, 1980). SAM is a wide-spread instrument for measuring these three dimensions in response to stimuli. As stated by Bradley and Lang (1994), it is inexpensive, easy and quickly in detecting affective responses to stimuli. Therefore it has often been used as an assessment instrument for developing standardized materials, for instance the International Affective Picture System (IAPS) (e.g. Lang et al., 2005). In addition to the SAM, each image was rated on disgust (1= not at all disgusting to 7 =

extremely disgusting) and sexuality (1= not at all sexually-laden to 7= extremely sexually-laden).

Figure 3A. Self-assessment manikin for arousal

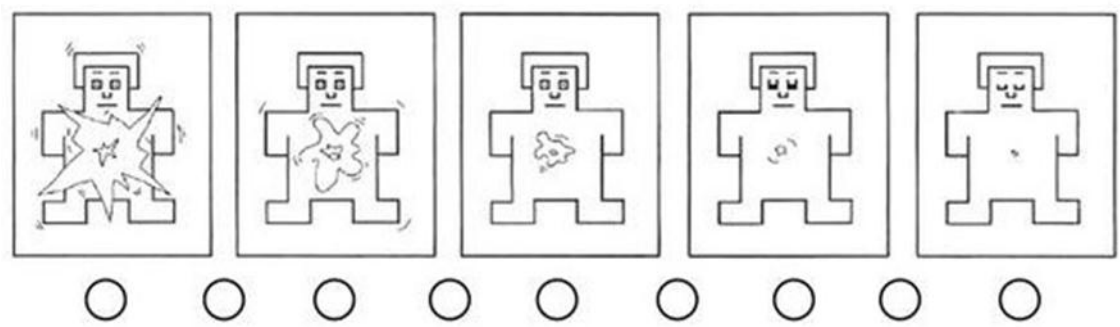


Figure 3B. Self-assessment manikin for valence

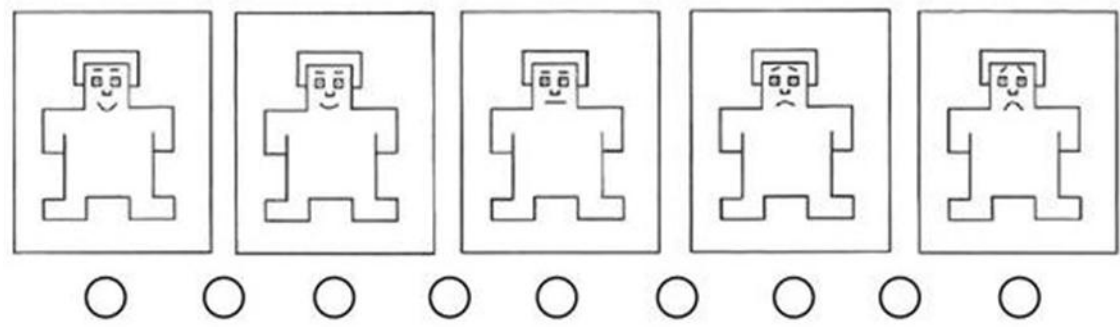
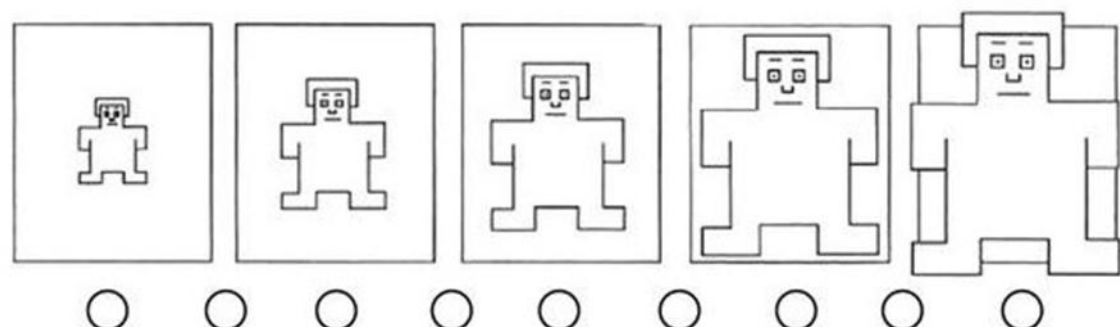


Figure 3C. Self-assessment manikin for dominance



Procedure

Before starting the test, subjects were familiarized with the scales and each of the represented dimensions (valence: 1 = higher end pleasant to 9 = higher end unpleasant; arousal: 1 = higher end excited to 9 = higher end calm; dominance: 1 = higher end dominated to 9 = higher end in control; disgust: 1 = not at all disgusting to 7 = extremely disgusting; sexuality: 1 = not at all sexually-laden to 7 = extremely sexually-laden). All images were presented one at a time on the screen and subjects were only able to move forward in the task. Each image was rated in the following order: valence, arousal, dominance, disgust-eliciting and sexual character. Subjects could follow their task progress at all times (i.e. presented as a percentage on screen). After approximately 20 minutes the test was finished and subjects were paid online.

Statistical Analyses

We aimed to retain 20 items for each category after the pre-test. Each of these images was selected based on the following requirements:

- hetero and homo images: scoring higher than '3' on sexuality.
- pathogen images: scoring lower than '2' on sexuality and scoring higher than '3' on disgust.
- neutral images: scoring lower than '2' on both disgust and sexuality.

The 20 images that were selected for each category would then be split up into two image samples (A and B). Both samples did not differ in mean scores on valence, arousal, dominance, sexuality and disgust.

Results

On the next page, an overview is provided of summarized outcomes for each image category, regarding valence, arousal, dominance, disgust and sexuality. These results are based on the data of the images selected for final use in the experiment (i.e. 20 images per category), split up in samples A and B.

Homosexual images (N=20)

	SAMPLE A		SAMPLE B	
	Mean	SD	Mean	SD
VALENCE	7.05	2.22	7.12	2.13
AROUSAL	6.94	1.77	6.98	1.86
DOMINANCE	4.83	.63	4.59	.85
DISGUST	4.12	2.28	4.36	2.12
SEXUAL NATURE	4.60	2.16	4.86	2.03

Heterosexual images (N=20)

	SAMPLE A		SAMPLE B	
	Mean	SD	Mean	SD
VALENCE	4.61	2.42	4.49	2.49
AROUSAL	5.67	1.48	5.59	1.97
DOMINANCE	5.22	.79	5.02	1.02
DISGUST	2.34	1.81	2.40	1.77
SEXUAL NATURE	5.02	1.32	5.64	.94

Pathogen cue images (N=20)

	SAMPLE A		SAMPLE B	
	Mean	SD	Mean	SD
VALENCE	7.21	1.22	7.23	1.29
AROUSAL	6.71	1.39	6.36	1.58
DOMINANCE	4.70	.66	4.35	.89
DISGUST	4.47	.95	4.93	.87
SEXUAL NATURE	1.07	.15	1.14	.19

Neutral images (N=20)

	SAMPLE A		SAMPLE B	
	Mean	SD	Mean	SD
VALENCE	3.09	1.62	2.68	1.27
AROUSAL	6.91	1.74	7.45	1.43
DOMINANCE	4.92	.71	4.84	.89
DISGUST	1.05	.08	1.07	.19
SEXUAL NATURE	1.05	.09	1.09	.20

Appendix 4. Overview of the Dutch (Belgian sample) and English (U.S. sample) stimuli words

	Belgian sample		U.S. sample	
IAT target concept	broer/zus incest		sibling incest	
IAT target stimuli	kussen strelen aaien neuken betasten likken ontkleden liefkozen		Kiss Caress Fondle Screw Grobe Lick Undress Stroke	
IAT attribute concepts	moreel juist	moreel verkeerd	morally right	morally wrong
IAT attribute stimuli	juist gepast moreel ethisch deugdzaam correct goed toegestaan	verkeerd ongepast immoreel onethisch verdorven vals slecht verboden	right appropriate moral ethical honest fair good allowed	wrong inappropriate immoral unethical corrupt unfair bad forbidden

Appendix 5. Example of a newspaper article (*Het Laatste Nieuws*, Belgium) about the potential legalisation of consensual sex between adult relatives in Romania.

Incest moet kunnen in Roemenië - HLN.be

pagina 1 van 1



[venster sluiten](#)



Denk aan het milieu. Denk na voor je print!

Incest moet kunnen in Roemenië

Door: redactie
23/03/09 - 12u39



Hoe verrassend het ook mag klinken: incest is niet altijd een probleem in Europa. In Frankrijk, Spanje en Portugal mogen familieleden zelfs straffeloos aan elkaar prutsen, op voorwaarde dat ze volwassen zijn en de seks met wederzijdse instemming gebeurt. Roemenië overweegt nu dezelfde regels in te voeren.

De zaak-Fritzi heeft het debat weer nieuw leven ingeblazen. Tot nu toe werd elke vorm van incest in Roemenië bestraft met celstraffen tot zeven jaar, maar de minister van Justitie wil daar verandering in brengen. "Niet al wat onzedelijk is, moet illegaal zijn", vindt wetsexpert Valerian Cioclei. "We helpen deze mensen niet door hen te brandmerken als criminelen."

Serieuze tegenwind

De minister krijgt intussen serieuze tegenwind, zowel in de meerderheid als bij het gewone volk. "Ik betwijfel dat incest in mijn land ooit met wederzijdse toestemming gebeurt", meent de 22-jarige Anuta Popa uit Cluj. "Bijna altijd valt de man in dronken toestand zijn zus of moeder aan. Als het aan mij ligt, ik zou ze castreren."

Een 27-jarige taxichauffeur ziet er echter geen graten in. "Als broers en zussen plezier willen maken, waarom moeten ze dan de cel invliegen? Wat ik in mijn slaapkamer uitsteek, gaat niemand aan", aldus Ionut Breazu. (svm)

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<http://www.hln.be/hln/nl/959/2009/article/print/detail/788433/Incest-moet-kunnen-in-R...> 01-11-14

